

EARLY DEATH: AN AMERICAN TRAGEDY*

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INTRODUCTION

The only public policy problems worth worrying about are those something can be done about. Nothing can be done about death: "Death as the Psalmist saith, is certain to all; all shall die."¹ Something can be done, however, about when death ends a lifetime. This article analyzes how much the United States can and should do, and how. The major finding is that an appropriate package of research, education, health care, and regulatory programs could probably avert hundreds of thousands of deaths, largely of relatively young persons, every year.

The analysis hinges on a simple but powerful distinction between "early" and "late" death. Age sixty-five is taken as the convenient, if rather arbitrary, dividing point between these two categories.² Early death differs from late death in both the nature of the losses and the character of the policy instruments that might be used to reduce these losses. When viewed through the conceptual lens of this distinction, some important features of the "death problem" come into focus that are blurred when death is viewed, as it usually is, in terms of "causes" of death. Some radical conclusions follow once these features are recognized. Most importantly, the conclusion seems inescapable that to the extent we value lives we should restructure the way we perceive the "health crisis" and the way we allocate health and safety expenditures by putting greater emphasis on that package of programs that could avert early deaths.

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1. W. SHAKESPEARE, *KING HENRY IV*, part II, act III, scene 2, line 41.

2. Clearly another dividing age might have been chosen—perhaps age 60, 62, 67, or 70—but age 65 is generally taken as the beginning of old age, at least in social policy legislation, and was convenient in terms of the availability of statistical data. In any case, the basic conclusions of the analysis in this article are insensitive to changes of a few years in the boundary. Later in this article, the periods before and after age 65 will be divided into a number of narrower age categories.

I

THE MAGNITUDE AND DISTRIBUTION OF THE LOSSES
DUE TO DEATH

A. Aggregate Losses

For the death problem, as well as for many other social problems,³ the bulk of the aggregate losses can be attributed to a minority of the people involved. Statistical averages are misleading here—what needs to be looked at is distribution. At current rates of mortality, the life expectancy of a United States citizen, at birth, is about seventy-two years. The median newborn can be expected to live three quarters of a century.⁴ As indicated in Figure 1, however, lifespans vary considerably. In particular, death cuts down a substantial proportion of Americans in their youth or middle years. More than a quarter of Americans born this year can be expected to die early, (*i.e.*, before age sixty-five). And given the current age distribution of the United States population, more than a third of total deaths are early ones: Of the almost two million people who died in the United States in 1974, nearly 700 thousand died early.⁵

These statistics, if turned around, imply that almost three-quarters of newborn children can be expected to live to age sixty-five or beyond, and nearly two-thirds of all deaths strike people age sixty-five and over. Thus it may appear at first glance that although the incidence of early death is substantial, death is principally a problem involving the elderly.

For the purposes of policy analysis, however, it will be useful to view the problem of death as involving not death per se but the amount of life lost as a result of death.⁶ Public programs cannot, at least at current levels of knowl-

3. For example, many people drink, smoke, or use marijuana, barbituates, heroin, or other drugs. The alcohol, smoking, and drug problems, however, principally involve those relatively few people who over-indulge. Most people violate the law occasionally—for instance, by speeding, cheating on taxes, or stealing some inexpensive item from a store or their place of work—but the crime problem is largely the product of those few people who seriously harm others. While millions of people in the United States are currently unemployed, the misery caused by unemployment is primarily experienced by the minority of the unemployed who have been, and can expect to remain, out of work for a prolonged period. Thousands of United States corporations have investments abroad, but four-fifths of this investment is controlled by two or three hundred very large firms—the problems created by the international expansion of business enterprises can be attributed in large measure to these relatively few firms, as discussed, for example, by R. VERNON, *SOVEREIGNTY AT BAY* (1971).

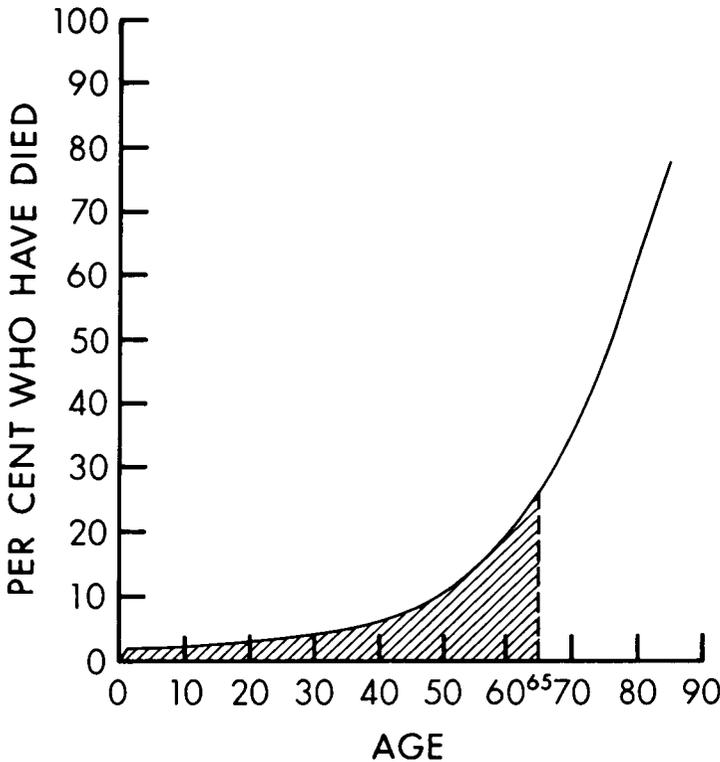
4. Nat'l Center for Health Statistics, *Final Mortality Statistics, 1974*, 24 MONTHLY VITAL STATISTICS REP. no. 11, at 5 (Supp. 1976) [hereinafter cited as *Mortality Statistics, 1974*]. The statistics presented in this report pertain to 1974, but since statistics of this kind change only slowly over time, I will occasionally use the word "current" in referring to them.

5. The statistics were calculated by the author on the basis of data in *Mortality Statistics, 1974*, at 5, 8.

6. Of course, death per se and its anticipation may cause anxiety, fear, and grief, both for dying individuals and for their families and friends, and it may be possible, through appropriate

edge, avert the inevitability of death. But public programs can influence when death strikes by altering the probability that death will occur early rather than late. Reducing the incidence of early death is more important than simple comparisons of number of early and late deaths suggest because early death deprives an individual of life—and society of the individual—for more years than late death.

FIGURE 1
DISTRIBUTION OF AGE AT DEATH



Discussion: The curve shows the percentage of people born in the United States in 1974 who will have died by various ages, if mortality rates remain at 1974 levels. The curve is not a prediction, since mortality rates will undoubtedly change, but rather it is a convenient way of depicting the existing pattern of mortality.

Source: Calculations by the author from data in *Mortality Statistics, 1974*, at 5.

Note: The curve ends at age eighty-five since statistics were only available until this age.

counseling, to help people face the fact of death. Here too, however, it may be useful to distinguish between early and late death. The severity of the psychological problems due to death tends to be inversely related to the age of the dying individual, at least for dying adults. Death seems more natural and less unfair, for the dying as well as for their family and friends, when it strikes in the ripeness of old age.

It is customary to speak of "lifesaving" and to evaluate health and safety programs in terms of number of "lives saved." But lives are never saved; they are prolonged. The gains attributable to a program that prolongs lives depend not only on how many lives are prolonged, but also on how long and at what level of quality.⁷ Consequently, from a policy perspective, the losses due to death should be measured not in number of deaths but in number of "quality-adjusted life-years" lost as a result of death.⁸ The quality of life tends to be greatest in youth and middle age, the "prime of life," and to decline in old age.⁹ As a rough and simple approximation, the average quality of life in

7. For further discussion of this point see Zeckhauser & Shepard, *Where Now for Saving Lives?*, 40 *LAW & CONTEMP. PROB.* no. 4, at 5 (1976). The phrase "quality-adjusted life years" is due to Zeckhauser and Shepard.

8. For the purposes of policy analysis it is not necessary to measure the losses due to death: What is required is a measure of the gains that could be achieved by a program that altered mortality rates. But if a measure of losses is available, gains can be readily calculated: The gains due to some program are simply the difference between the losses under that program and the losses under the status quo. Consequently, the measures of losses discussed in the following paragraphs are perhaps best viewed as measures of potential gains. Later in this article the gains from various programs that alter mortality will be calculated in terms of the reduction in quality-adjusted life-years lost, measured as described below.

9. There are, of course, exceptions: For some the "glorious sunset years" may be the best years of life. But as Swift wrote, "[e]very man desires to live long, but no man would be old." Swift, *Thoughts on Various Subjects, 1711*, quoted in J. BARTLETT, *FAMILIAR QUOTATIONS* 295 (13th ed. 1955).

Two surveys by the author of students in an undergraduate course at Duke University provide some evidence for this contention, although the sample is admittedly a very unrepresentative one. In the first survey, each student was asked to assess the expected quality of his or her own life at various ages. The decade between thirty and forty served as the standard: These ten years were defined as being equivalent to ten quality-adjusted life-years. The students then assessed the expected value of other decades of their life in terms of the number of quality-adjusted life-years equivalent to the ten years in these decades. Some sixty students participated in this survey; the distribution of their responses is summarized below. The median, lower-quartile and upper quartile responses all decline with age.

Number of Quality-Adjusted Life-Years
Equivalent to the Ten Years in This Decade

<i>Decade of life</i>	<i>Lowest response</i>	<i>Lower-quartile response</i>	<i>Median response</i>	<i>Upper-quartile response</i>	<i>Highest response</i>
20-30	6.	10.	11.	12.	20.
30-40	(10.)	(10.)	(10.)	(10.)	(10.)
40-50	8.5	9.	9.9	10.	15.
50-60	7.	8.5	9.	10.	24.
60-70	5.5	7.	8.	9.	21.
70-80	1.	5.3	6.	8.	14.

In the second survey each student was asked, among other things, to assess his or her optimal life-span. The students were asked to consider only ages between their current age and age 100: Students who felt that the best life was the longest possible life, or who felt that their optimal life-span exceeded 100 years were asked to write age "100" as their answer. Some 50 students responded: The median response was age 85; the lower quartile response age 80; the upper quartile response age 90; and the lowest response age 70; the response of six students was the maximum permitted response of age 100. Copies of the questionnaires and data from which this table was calculated are on file with the author.

the years before age sixty-five might be assumed to be constant,¹⁰ and quality of life in later years assumed to decrease steadily, approaching zero at age ninety.¹¹ Measured in this way, 27 million quality-adjusted life-years are currently lost each year—of which more than 22 million, or about five-sixths, are lost by people dying early.¹² Thus, as shown in Figure 2, while only a minority of deaths are early ones, these deaths account for most of the losses.

A number of other measures of the losses due to death can be devised; all, like the quality-adjusted life-years measure, are imperfect but nonetheless informative. Some of these measures are summarized in Table I.¹³ Regardless of the measure used, the message is the same: Losses due to death are largely attributable to early death—and these losses are very large.

B. Early Deaths Among the Disadvantaged

The losses due to early death are even more grievous than these aggregate statistics indicate because two disadvantaged groups, non-white¹⁴ and the poor, suffer a disproportionate share of the loss. Non-whites are considerably more likely to die early than whites. Currently, over half (55 per cent) of all non-white deaths each year are early deaths, compared with less than one third of white deaths.¹⁵ Furthermore, a newborn nonwhite child can expect a 39 per cent chance of early death, compared with a 24 per cent chance for a newborn white.¹⁶ Although nonwhites constitute only an eighth of the United States population,¹⁷ nonwhites account for almost a fifth of all early deaths

10. This implies that the years of childhood have the same quality as the years between childhood and old age. Some people might feel the childhood years should be assigned a lower (or higher) level of quality. Since relatively few people die during childhood and the people who do so lose their later years as well as some of their childhood years, assuming another level of quality for childhood will not significantly affect the results of the analysis.

11. More formally, the quality of life at age a , $65 \leq a \leq 90$, is given by $1 - (a - 65)/25$; at or below age 65 the quality of life is 1 and at or above age 90 the quality of life is 0. This formulation, it should be emphasized, is used only as a rough and simple approximation. The assumption that the quality of life after age 90 is zero may be questionable, but it is not significant, as relatively few life years are lived beyond age 90. Assigning some higher level of quality would hardly alter the statistics presented in this article.

12. See Figure 2 *infra* for source of and notes on these figures.

13. One kind of measure, the kind based on "willingness to pay," was omitted from Table I because suitable data were not available. For a discussion of this kind of measure see Acton, *Valuing Lifesaving—Alternatives and Some Measurements*, 40 LAW & CONTEMP. PROB. n. 4, at 46 (1976).

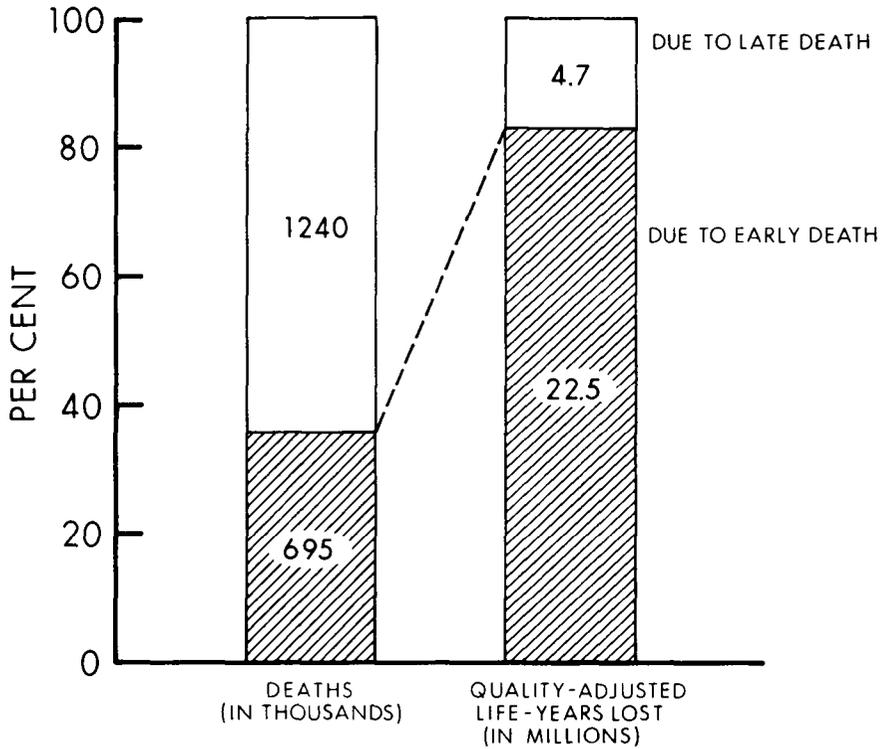
14. Mortality statistics in the various sources used for this article are given for "whites" and "nonwhites," sometimes called "all others." Consequently, throughout this article, I will refer to the category "nonwhites" rather than the perhaps more natural category of "blacks" or "Negroes." In 1974, about 88 per cent of nonwhites were classified as Negroes. See U.S. BUREAU OF THE CENSUS, STATISTICAL ABSTRACT OF THE UNITED STATES: 1975, at 26 table 26 (1975) [hereinafter cited as STATISTICAL ABSTRACT: 1975].

15. Calculated by the author from data in *Mortality Statistics, 1974*, at 8.

16. Calculated by the author from data in *Mortality Statistics, 1974*, at 6, 7.

17. STATISTICAL ABSTRACT: 1975, at 26.

FIGURE 2
DEATHS AND QUALITY-ADJUSTED LIFE-YEARS LOST DUE TO
EARLY AND LATE DEATH IN 1974



Discussion: Although only 36 per cent of all deaths in the United States in 1974 were early deaths, *i.e.*, deaths of people under age 65, these early deaths accounted for 83 per cent of the "quality-adjusted life-years lost."

Source: Calculations by the author from data in *Mortality Statistics, 1974*, at 8.

Notes: As discussed in Table 1, *infra*, there are a number of different ways of measuring "life-years lost" and "quality-adjusted life-years lost." The measure used here is the one described in the text: quality-adjusted life-years lost before age 90 assuming constant quality up to age 65 and linearly declining quality from age 65 to age 90.

Deaths are reported in *Mortality Statistics, 1974* by 19 age categories: "under 1," "1-4," "5-9," "10-14," and so on by 5-year groups up through "80-84," and "85 years and over." I assume that half the people who die after age 85 die before age 90. Figures for "quality-adjusted life-years lost" were calculated as the sum of the products of the number of deaths in each of the relevant categories and the number of quality-adjusted life-years lost at the average age of death in the category. The average ages of death were assumed to be 0, 3, 7.5, 12.5, and so on by increments of 5 up to 87.5. The number of quality-adjusted life-years lost in the nineteen categories from "under 1" to "85-90" were 77.5, 74.5, 70, 65, 60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10.125, 6.125, 3.125, 1.125, and 0.125, respectively.

TABLE I
ALTERNATIVE MEASURES OF THE LOSSES DUE TO DEATH

Measure ¹	Losses Due to Early Death	Total Losses Due to Death	Percentage of Losses Due to Early Death ²
Quality-adjusted life-years lost ³	22 million	27 million	83%
Quality-adjusted life-years lost (based on a different quality adjustment) ⁴	27 million	31 million	85%
Discounted quality-adjusted life-years lost ⁵	10 million	14 million	74%
Life-years lost before age 90 ⁶	31 million	45 million	68%
Life-years lost before age 70 ⁷	17 million	18 million	97%
Years of life-expectancy lost ⁸	23 million	36 million	65%
Discounted earnings lost ⁹	\$64 billion	\$71 billion	89%

Source: Calculations made by author from data in *Mortality Statistics, 1974*, at 5 table 2; 8 table 3, except for "discounted earnings lost." See note 9 *supra*.

Notes: 1. Each of the measures, except the last, was calculated from data in *Mortality Statistics, 1974*. Data in this source are presented for 19 age groups—0 to 1, 1 to 5, 5 to 10, 10 to 15, . . . , 80 to 85, and 85 and over. Data are not tabulated for individual ages. Consequently, the statistics presented in this article based on *Mortality Statistics, 1974*, or similar sources are approximations. The category "85 and over" was divided into the two categories of "85 to 90" and "90 and over" when it was necessary to do so to calculate statistics presented in this article. It was assumed that half of the deaths after age 85 occur before age 90. This is probably a reasonable approximation since life-expectancy at age 85 is given as 5.7 years. *Mortality Statistics, 1974*, at 5.

2. The percentages given may not equal the quotient of the loss figures because these figures have been rounded off.

3. This is the measure discussed in the text. The measure is calculated as $\sum n_i Q_i$, where n_i is the number of deaths in age-category i (for the 20 age-categories discussed in note 1 *supra*) and Q_i is the number of quality-adjusted life-years lost by the average person dying in age-category i . Q_i

is given by $\sum_{j=a_i}^{90} q_j$, where a_i is the age at death of the average person in category i and q_j is the

quality of life at age j . For the five-year long age categories from 5 to 10 through 85 to 90, the average dying person was assumed to be halfway through the age category, e.g., $7\frac{1}{2}$ in the 5 to 10 category, and $87\frac{1}{2}$ in the 85 to 90 category. For the categories 0 to 1 and 1 to 5, the average dying person was assumed to be 0 and 3, respectively. The quality of life at age j , q_j , is given by $1-(j-65)/25$ where $65 \leq j \leq 90$; at or below age 65 the quality of life is 1 and at or above age 90, the quality of life is 0. This formulation, it should be emphasized, is used only as a rough and simple approximation. The assumption that the quality of life after age 90 is zero is questionable but it is not significant, because relatively few life years are lived beyond age 90: assigning some higher level of quality would hardly alter the statistics.

4. This measure is similar to the previous measure except that the decline in quality of life after age 65 is not linear but negative exponential, "decaying" with a half-life of ten years. That is, the quality of life at age j , for $j \geq 65$, is given by: $(.5)^{(j-65)/10}$.

5. This measure is similar to the first measure except that life-years are "discounted" at a rate of 5 percent. That is, Q_i is given by: $\sum_{j=a_i}^{90} \frac{1}{1.05^{a_i-j}} q_j$. For some purposes it may be appropriate to discount future life-years: see Zeckhauser & Shepard, *supra* note 7; for other purposes it may be inappropriate: see J. RAWLS, A THEORY OF JUSTICE 420 (1971).

6. This measure is similar to the first measure except that there is no quality adjustment. That is, q_j equals 1 for all ages up to age 90.

7. This measure is similar to the previous measure except that the cut-off point is age 70, the biblical three-score-and-ten, rather than age 90.

8. This measure assumes that a person dying at some age loses the life-expectancy (*i.e.*, the average remaining life-span) of persons of that age who survive. In calculating this measure, the 19 age categories given in *Mortality Statistics, 1974*, were used. See note 1 *supra*. Life-expectancies at ages 3, 7½, . . . , 82½ were estimated by interpolation; the life-expectancy of the average person in the 85 and over category was estimated by extrapolation to be 4.2 years.

9. This measure is from Cooper & Rice, *Economic Cost of Illness Revisited*, 39 SOC. SECURITY BULL. 21, 30 table 6 (Feb. 1976). See their article for a full explanation and, for a critique of this kind of measure, see Acton, *supra* note 13.

and more than a fifth of the quality-adjusted life-years lost.¹⁸ This is clearly a glaring inequality, representing perhaps the harshest single deprivation in the life chances of nonwhites.

The poor also seem to suffer from a high early death rate, although the evidence on this is spottier and less precise than the mortality data for whites and nonwhites. A Public Health Service study, for example, found: "People living in poverty areas experienced far higher crude death rates (50 to 100 percent higher generally) than people living in higher income areas, regardless of race. This was true in spite of the generally younger population in poverty than in nonpoverty areas."¹⁹

18. Calculated by the author from data in *Mortality Statistics, 1974*, at 8.

19. NAT'L CENTER FOR HEALTH STATISTICS, SELECTED VITAL AND HEALTH STATISTICS IN POVERTY & NONPOVERTY AREAS OF 19 LARGE CITIES, UNITED STATES, 1969-191, at 7 (DHEW Pub. No. 76-1904, 1975); NAT'L CENTER FOR HEALTH STATISTICS, HEALTH, UNITED STATES: 1975, at 243, 253, 437, 439 (DHEW Pub. No. 76-1232, 1976). The data in these tables indicate that the poor assess their health status as "poor" or "fair" much more frequently than persons with higher incomes and that the poor suffer much higher rates of "restricted activity days," "bed disability days," and "work loss days." U.S. DEP'T OF HEALTH, EDUCATION, AND WELFARE, VITAL AND HEALTH STATISTICS, INFANT MORTALITY RATES, SOCIOECONOMIC FACTORS I (1972). Three indexes of socioeconomic status were examined—education of father, education of mother, and family income in the year prior to the birth or the infant death. All three indexes showed a strong association with risk of infant death, this risk being between 50 and 100 per cent higher in the lowest socioeconomic class than in the middle and upper classes.

Another relevant study is E. KITAGAWA & P. HAUSER, DIFFERENTIAL MORTALITY IN THE UNITED STATES: A STUDY IN SOCIOECONOMIC EPIDEMIOLOGY (1973). Among other findings, this study reports that in 1960, "white males 25 to 64 of lower education (less than five years of school) experienced mortality 64 percent above that of men with higher education (four years of college). Among white females the comparable differential was 105 percent," *id.* at 152, and that, "[d]ifferentials in mortality by income were in general pattern similar to those by education." *Id.* at 153. See also Antonovsky, *Social Class, Life Expectancy and Overall Mortality*, 45 MILBANK MEMORIAL FUND Q. 31 (1967) (summarizes the similar results of a number of earlier studies).

In addition to non-whites and the poor, women are often categorized as a "disadvantaged" group. But in terms of early death, it is men who are severely disadvantaged. Among teenagers and twenty-year olds, the male death rate is almost three times as high as the female rate, and among 30, 40, 50, and 60-year olds, almost twice as high. Males account for nearly two-thirds of all early deaths as well as nearly two-thirds of the quality-adjusted life-years lost as a result of early death.²⁰

C. Lifespan Inequality

Because the bulk of the losses due to death are suffered by the minority who die early, there is a striking disparity in the lifespans of the early and late dead. At current mortality rates the 26 per cent of newborns who can be expected to die before age sixty-five will die, on the average, at age forty-seven and will lose more than thirty quality-adjusted life-years. On the other hand, the 74 per cent who survive into old age will live, on the average, until age eighty-one—their average loss will be just three quality-adjusted life-years.²¹ Thus, those dying early will average only 58 per cent as long a lifespan as their more fortunate contemporaries and will be deprived by death of fully ten times as many quality-adjusted life-years.

While considerable and growing attention is given to various kinds of inequality, especially income and racial inequality, and rightly so, hardly any attention has been focused on lifespan inequality. Yet this inequality is surely among the greatest of all inequalities in life-chances in the United States.

Michael Grossman asserts that the age-adjusted mortality rate is positively correlated with income across states of the United States. M. Grossman, *The Demand for Health, A Theoretical and Empirical Investigation* 13 (Nat'l Bureau of Economic Research Occasional Paper No. 19, 1972). Auster, Leveson, & Sarachek, *The Production of Health, An Exploratory Study*, 4 J. HUMAN RESOURCES no. 4, at 411, 421 (1969) give a value of 0.447 for this correlation for white populations. Such a correlation does not rule out the possibility that the poor have higher early death rates, for a number of reasons, including (1) the poor could have high early death rates but low late death rates (perhaps because the poor who do survive into old age have particularly strong constitutions); (2) the relationship between income and mortality rates could be curvilinear, with both the poor and the rich suffering from high mortality rates; or (3) the reason rich states tend to have high mortality rates might be that the poor in these states have particularly high mortality rates. The study by E. KITAGAWA & P. HAUSER, *supra* at 163-65 that, as reported above, found a negative correlation between income and mortality at the individual level also found a positive correlation at the level of states and other geographical areas. As Kitagawa and Hauser write:

[T]he relationship between geographic variations in mortality and average socioeconomic level of geographic areas . . . should be emphasized, and should not be interpreted as indicating relationships between mortality and socioeconomic characteristics of individuals. The findings are presented as ecological correlations, significant in their own right, and not as measurement[s] of the relationships between mortality and characteristics of individuals presented in other chapters of the study.

Id. at 168.

20. Calculated by the author from data in *Mortality Statistics, 1974*, at 8.

21. Statistics calculated by the author from data in *Mortality Statistics, 1974*, at 5.

Those who will die early comprise more than a quarter of the population,²² as opposed to 12 per cent or so for the poor²³ and 13 per cent for nonwhites.²⁴ And their deprivation—and the loss to their friends and family—is very great. Death in general, and early death most of all, deprives an individual of further chances for happiness, love, accomplishment, service, or even struggle against adversity. Moreover, early death precludes the orderly completion of life.²⁵ It seems apparent that most people, including most poor people and most nonwhites, would prefer continued life, deprived as it may be, if given the choice over the tragic alternative of early death.²⁶ As the shade of Achilles lamented to Odysseus,²⁷

never try to console me for dying.
I would rather follow the plow as thrall to another
man, one with no land allotted him and not much to live on,
than be a king over all the perished dead.

In some ways it may seem strange to compare the early dead with disadvantaged groups. Poor people and nonwhites are visible and vocal, and the effects of poverty and racial discrimination can be at least partially corrected. Those who have died early, on the other hand, are invisible and voiceless, and nothing can restore them to life. Those who will die early unless appropriate action is taken²⁸ are rarely aware of how unfortunate they are. But the fog of uncertainty that obscures who will die when, and the tragic certainty that death is final are no reasons for ignoring the enormous deprivation caused by early death and no excuses for neglecting to try to avert it.

Racial discrimination and poverty are major national problems worthy of

22. More precisely, at 1974 mortality rates a newborn child had about a 26 per cent chance of dying before age 65 and 36 per cent of the people who died in 1974 were under age 65. These statistics were calculated by the author on the basis of data in *Mortality Statistics, 1974*, at 5, 8.

23. In 1974, 11.6 per cent of all persons in the United States fell below the "low income level." This level is defined by a "poverty index" developed by the Social Security Administration. See STATISTICAL ABSTRACT: 1975, at 399 table 652, 378.

24. STATISTICAL ABSTRACT: 1975, at 26 table 26.

25. As Laurence Tribe put it (at the Conference on *Valuing Lives*, Amelia Island, Florida, March 12, 1976), "the life that ends too soon is like an unfinished symphony."

26. The results of a survey by the author of 81 students in an undergraduate course at Duke University were consistent with this assertion. Among other questions, the students were asked to consider the life of a hypothetical person, called Jack Richardson, who was 22 years old, was about to graduate from Duke, and was going to live, for the rest of his life, at a consumption level of \$4,000 per year. Some 94 per cent of the 81 students felt that living until age 45 was preferable to dying at age 30; 79 per cent felt that living until age 60 was preferable to dying at age 45; 65 per cent felt that living until age 70 was preferable to dying at age 60; and 63 per cent felt that living until age 80 was preferable to dying at age 70. Copies of the questionnaire and data from which these statistics were calculated are on file with the author. A brief description of the survey is in G. Fischer & J. Vaupel, *A Life-span Utility Model: Assessing Preferences for Consumption and Longevity 3* (unpublished working paper on file at Institute of Policy Sciences and Public Affairs, Duke University).

27. THE ODYSSEY OF HOMER bk. XI, lines 488-91 (R. Lattimore transl. 1967).

28. *I.e.*, the kinds of programs discussed in the text at Part IV *infra*.

substantial attention. In comparing them to early death, I do not mean to disparage them: On the contrary, my intention is to emphasize the magnitude of inequality produced by early death. Moreover, concern about early death is congenial to concern about racial discrimination and poverty since, as indicated earlier, nonwhites and the poor disproportionately suffer from early death. A reduction in the incidence of early death would be a major step toward improving the lot of these disadvantaged groups.

II

SOME EVIDENCE SUGGESTING THAT EARLY DEATH COULD BE REDUCED

The immense aggregate losses and the egregious inequalities described above suggest that the problem of early death may well deserve greater attention. How much attention depends on how much can be done about early death. Some relevant bits and pieces of evidence are presented below. The thrust of the evidence is that early death could probably be substantially reduced.

A. The Nonwhite/White Differential

The large differential between nonwhite and white early death rates suggest that it might be possible to decrease the incidence of early death among nonwhites. If nonwhite early death rates were reduced to white levels, nearly 60 thousand early deaths would be averted, and nearly two million quality-adjusted life-years would be saved every year.²⁹

B. The Male/Female Differential

The large differential between male and female early death rates is similarly suggestive, especially since there is some evidence that this differential is a result of environmental and behavioral factors rather than genetics.³⁰ If male early death rates could be reduced to female levels, early deaths would be cut from nearly 700 thousand to less than 500 thousand per year and the quality-adjusted life-years lost as a result of early death would be cut from over 22 million to less than 16 million per year.³¹

C. The Historical Trend

A third bit of suggestive evidence is the long-term downward trend in the likelihood of early death, as shown in Figure 3. The causes of this trend are

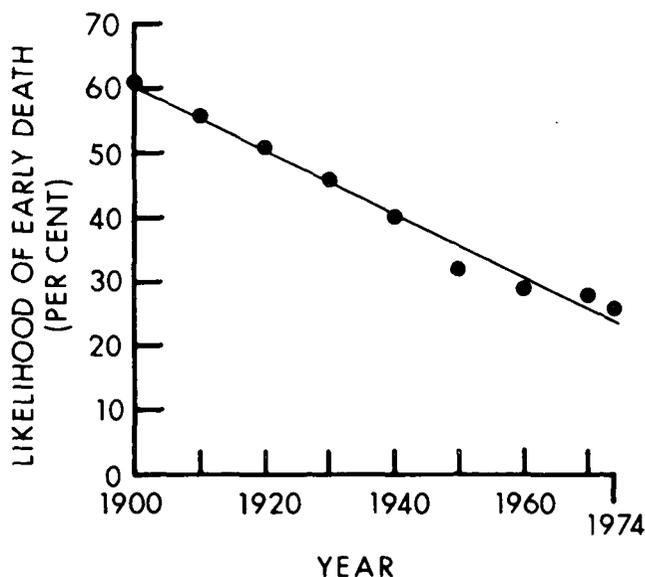
29. Calculated by the author from data in *Mortality Statistics, 1974*, at 8. More precisely, the figures are 57 thousand and 1.96 million, respectively.

30. See Waldron, *Why do Women Live Longer Than Men?*, 2 J. HUMAN STRESS 2, 19 (March, June 1976).

31. Calculated by the author from data in *Mortality Statistics, 1974*, at 8. More precisely, 219 thousand early deaths would be averted and 6.77 million quality-adjusted life-years would be saved.

uncertain: some scholars stress the role of medical progress; others, progress in hygiene and education.³² Regardless of its causes, the trend indicates that the incidence of early death is not immutable. At current population levels, every additional reduction of one percentage point in the incidence of early death would avert more than 25 thousand early deaths per year.³³ If the long-run rate of progress in reducing early death could be continued, then early death would be conquered in half a century.

FIGURE 3
LIKELIHOOD OF EARLY DEATH FROM 1900 TO 1974



Discussion: The likelihood of early death has declined in the United States by about five per cent per decade since 1900.

Source: The figures for 1900 through 1960 were calculated by the author on the basis of data in *CAUSES OF DEATH 725-67*. The figure for 1970 is from *MORTALITY STATISTICS 1970*, at 5-3 table 5.1. The figure for 1974 is from *Mortality Statistics, 1974*, at 8.

Note: The "likelihood of early death" is given by the percentage of newborns in a given year who would die before age sixty-five if mortality rates at ages up to age sixty-five remained at the levels prevailing in that year.

32. See R. DUBOS, *MIRAGE OF HEALTH* 109-215 (1959); H. SIGERIST, *CIVILIZATION AND DISEASE* 6-42, 229-42 (1943); I. ILLICH, *MEDICAL NEMESIS* 15 (M. Boyars ed. 1975).

33. More precisely, if age-specific death rates in 1974 had been at 1970 levels, more than 50 thousand additional early deaths would have occurred in 1974. This figure was calculated by the author from data in *Mortality Statistics, 1974*, at 8; 2 NAT'L CENTER FOR HEALTH STATISTICS, *VITAL STATISTICS OF THE UNITED STATES: 1970—MORTALITY, PART A 5-3*, table 5.1 (DHEW Pub. No. 75-1101, 1974) [hereinafter cited as *MORTALITY STATISTICS 1970*].

D. Early Death as an American Tragedy

Perhaps the most striking evidence suggesting that the incidence of early death in the United States might be substantially reduced is the comparison with other countries shown in Figure 4. The United States falls near the bottom of the list, behind the other major industrialized nations and behind some less developed countries as well. In Sweden, which ranks first, the likelihood of early death is a third less than it is in the United States. If United States early death rates could be reduced to Swedish levels, nearly a quarter of a million early deaths could be averted, and more than eight million quality-adjusted life-years could be saved, every year.³⁴

The poor performance of the United States is not a recent phenomenon: The likelihood of early death in the United States has been higher than that in most other developed countries for at least several decades.³⁵ Furthermore, the gap appears to be widening: the performance of the United States has tended over time to become relatively worse.³⁶

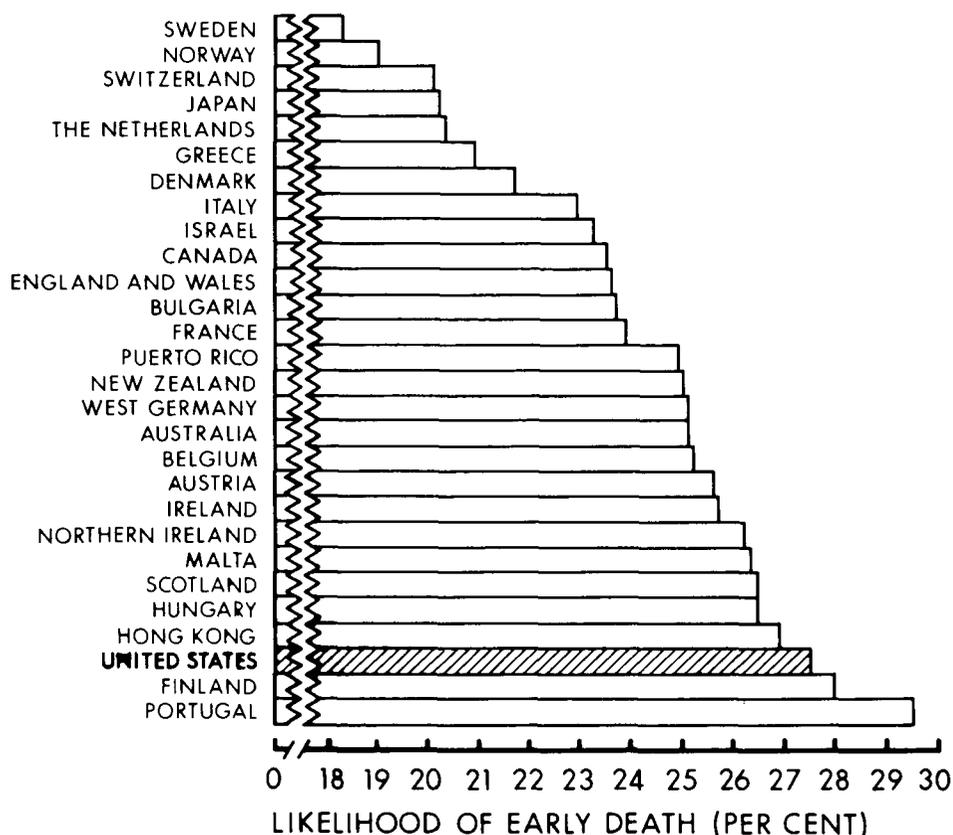
34. Calculated by the author on the basis of Swedish data for 1972 in *DEMOGRAPHIC YEARBOOK 1975*, at 178 table 6, 930 table 29 (1975) [hereinafter cited as *DEMOGRAPHIC YEARBOOK 1975*]; United States data for 1974 in *Mortality Statistics, 1974*, at 8.

35. Data for 1964 for the countries and regions listed in Figure IV show the United States ranking behind Sweden (which experienced a likelihood of early death only 68 per cent as high as the United States level), Norway (69 per cent), the Netherlands (71 per cent), Denmark (77 per cent), Greece (77 per cent), Switzerland (79 per cent), Israel's Jewish population (80 per cent), Bulgaria (81 per cent), England and Wales (86 per cent), France (86 per cent), Canada (87 per cent), New Zealand (87 per cent), Japan (90 per cent), Italy (90 per cent), Belgium (90 per cent), Hungary (91 per cent), Northern Ireland (91 per cent), Austria (93 per cent), Australia (93 per cent), West Germany (93 per cent), Puerto Rico (98 per cent), and Malta (98 per cent), but ahead of Scotland (101 per cent), Hong Kong (101 per cent), Finland (102 per cent), and Portugal (107 per cent); data for Ireland was not available. Data for 1951 show the United States ranking behind Norway (66 per cent), the Netherlands (69 per cent), Sweden (72 per cent), New Zealand (84 per cent), Israel's Jewish population (87 per cent), Switzerland (88 per cent), Canada (91 per cent), England and Wales (92 per cent), and Australia (92 per cent), but ahead of France (101 per cent), Scotland (106 per cent), Finland (111 per cent), and Japan (129 per cent); data were not available for the other countries and regions listed in Figure 4. Finally, data for 1920 for the United States, Norway, Sweden and for 1921 for Australia, Canada, Denmark, England, and Wales, Italy, and New Zealand show the United States ranking behind New Zealand (72 per cent), Denmark (76 per cent), Australia (81 per cent), Canada (82 per cent), Norway (85 per cent), Sweden (85 per cent), and England and Wales (88 per cent), but ahead of Italy (103 per cent). These percentages were calculated by the author from data in S. PRESTON, N. KEYFITZ, & R. SCHOEN, *CAUSES OF DEATH 68-787* (1972) [hereinafter cited as *CAUSES OF DEATH*].

36. Data are available for 1964, as well as for 1972, for all the countries and regions listed in Figure IV, except Ireland: For these countries and regions, on the average, the likelihood of early death in 1964 was 88.0 per cent as high as in the United States—in 1972, the figure was 87.1 per cent. Data are available for twelve countries and regions, other than the United States, for 1951 as well as 1972: Sweden, Norway, Switzerland, Japan, the Netherlands, Canada, England and Wales, France, New Zealand, Australia, Scotland, and Finland. For these countries and regions, the average likelihood of early death was 91.8 per cent of the United States figure in 1951 and 82.9 per cent in 1972. Finally, data are available for eight countries and regions, other than the United States, for 1920-21 as well as for 1972: Australia, Canada, Denmark, England and Wales, Italy, New Zealand, Norway, and Sweden. For these countries and regions, the average likelihood of early death was 84.1 per cent of the United States figure in 1920-21 and 81.4 per cent in 1972. These percentages were calculated by the author from data in *CAUSES OF DEATH*.

FIGURE 4

LIKELIHOOD OF EARLY DEATH IN VARIOUS COUNTRIES AND AREAS



Discussion: The United States ranks twenty-sixth, behind all other major developed countries and behind Bulgaria, Puerto Rico, and Hong Kong. In top-ranked Sweden, the likelihood of early death is only two-thirds of the United States level.

Source: Calculations by the author from data in DEMOGRAPHIC YEARBOOK 1974, at 644-705 table 26, 1062-84 table 35.

Notes: Countries were included in this chart only if data were available for 1972, 1971, 1973, or a period of years including 1972, in that order of preference. Data for Finland, Hong Kong, New Zealand and Portugal are for 1971; for Australia, Austria, Bulgaria, France, Greece, Hungary, Iceland, Israel, Japan, the Netherlands, Sweden, and the United States, for 1972; for Malta, for 1973; for Belgium, for 1968-1972; for Switzerland, for 1969-1972; for Canada, England and Wales, Italy, Northern Ireland, and West Germany, for 1970-1972; for Denmark and Norway, for 1971-1972; and for Puerto Rico and Scotland, for 1971-1973. Data for Australia, Austria, Bulgaria, Greece, Ireland, Japan, New Zealand, and Switzerland were calculated from age-specific mortality rates given in DEMOGRAPHIC YEARBOOK 1974, at 644-705 table 26; data for other countries were calculated from "survivor percentages" given in *id.* at 1062-1084 table 35. In each case, the figures given in the figure are simple averages of male and female figures.

The United States is accustomed to view itself as the world's leading developed country. In terms, however, of the incidence of early death—which is surely a key indicator of quality of life—the United States is a relatively backward and deprived nation. Early death is an American tragedy, clearly one of our greatest shortcomings.

E. Causes of Early Death

An analysis of the causes of early death yields some further evidence suggesting that early deaths could be substantially reduced. As shown in Figure 5, four major causes of death—cardiovascular disease, cancer, infant mortality, and accidents and homicides—account for nearly four-fifths of early deaths and of the quality-adjusted life-years lost as a result of early death. In terms of the life-years measure, the four causes are of roughly equal importance.

For each of these causes, the likelihood of early death is higher for nonwhites than whites, males than females, and Americans than Swedes, as shown in Figure 6. Some of these differentials are strikingly large. For example, the likelihood of early death due to cardiovascular disease is nearly two and a half times higher among males than females and nearly twice as high among Americans than Swedes. The rate of infant mortality is almost twice as high among nonwhites than whites and some seventy per cent higher among Americans than Swedes; and the nonwhite early death rate from accidents and homicides is nearly one and a half times the white rate, while the male rate is almost three times the female rate. If homicides, which account for a fifth of all early deaths in this last category,³⁷ are considered separately, an even more glaring differential appears: The likelihood of early death from homicide is nearly nine times higher among nonwhites than whites.³⁸

F. Taking Stock

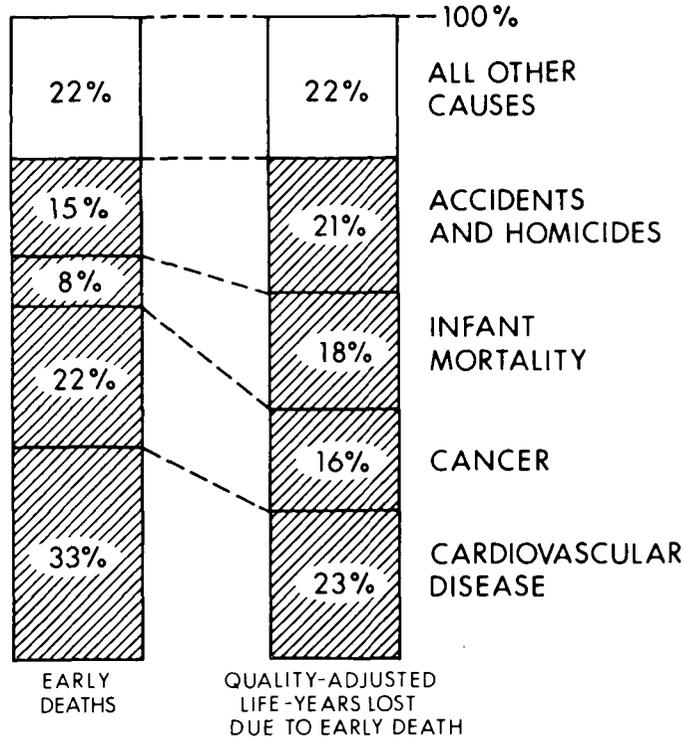
The statistics presented thus far indicate that the aggregate social losses due to death are largely attributable to early death and that the losses due to early death are immense; that the early dead suffer an egregious inequality in life-chances compared with those who die in old age; and that nonwhites, the poor, and males suffer disproportionately from early death. Furthermore, statistics on the leading causes of death and statistics comparing nonwhites and whites, males and females, current mortality with mortality earlier in this country, and the United States with Sweden and other countries suggest that early deaths could be significantly decreased. Collectively, these statistics constitute a strong case for focusing attention on early death.

37. Calculation by the author from data in *Mortality Statistics, 1974*, at 12, 13 table 6.

38. And the male rate is more than four times the female rate. These figures were calculated by the author from data in 2 NAT'L CENTER FOR HEALTH STATISTICS, VITAL STATISTICS OF THE UNITED STATES: 1972—MORTALITY, PART A 1-26 to 1-43 (DHEW Pub. No. 76-1101, 1976) [hereinafter cited as MORTALITY STATISTICS 1972].

FIGURE 5

BREAKDOWN OF EARLY DEATHS AND QUALITY-ADJUSTED LIFE-YEARS LOST, ACCORDING TO MAJOR CAUSES OF DEATH



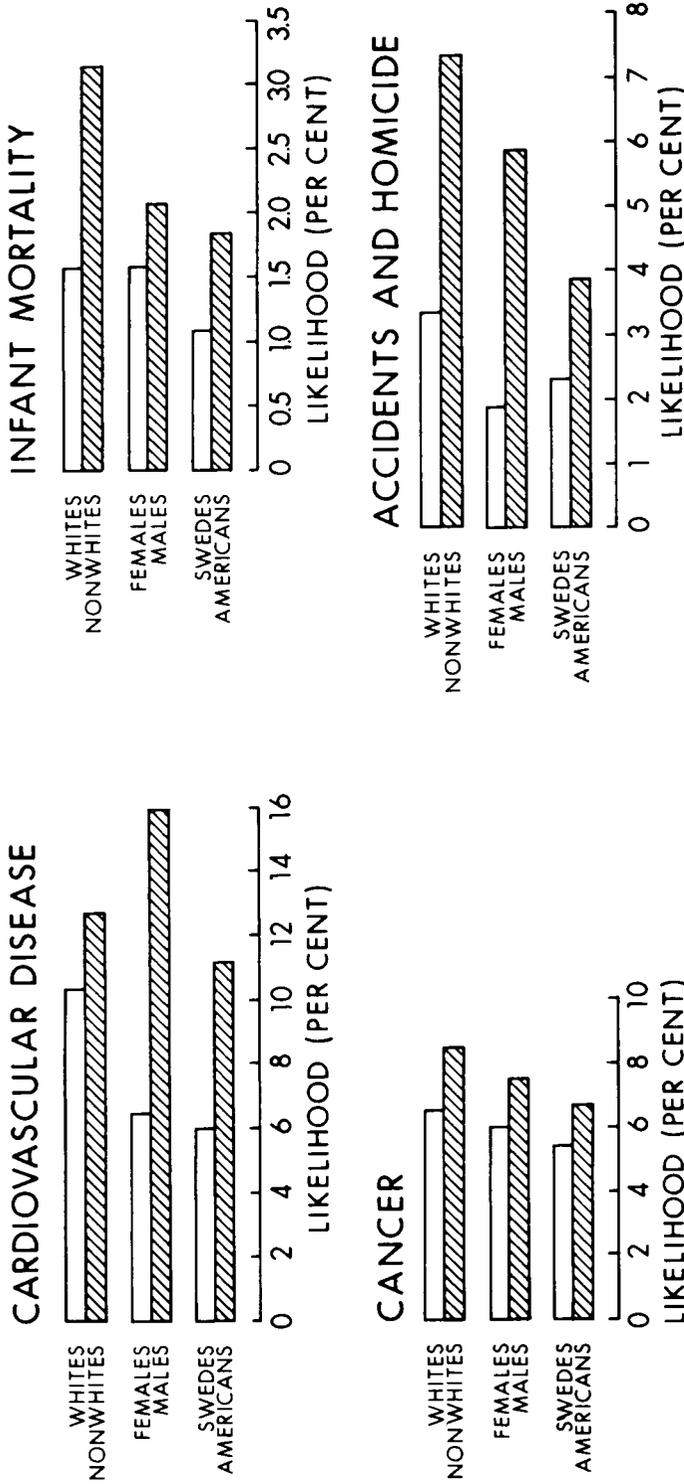
Discussion: Four major causes account for nearly four-fifths of early deaths and of quality-adjusted life-years lost due to early death. In terms of the latter measure, the four causes are of roughly equal importance.

Source: Calculations by the author from data in *Mortality Statistics, 1974*, at 12-15 table 6.

Notes: The data are for 1974. "Infant mortality" consists of all deaths of infants under age 1 and only such deaths; the percentage figures on the other causes of death are based on deaths in these categories of individuals above age 1. "Cancer" represents the category more formally called "malignant neoplasms." "Accidents and homicides" include all "external" causes of death, except suicide.

But before turning to what specifically the United States can and should do about early death, a missing link in the argument needs to be forged. Why focus on early death, rather than death in general? Why distinguish between early and late death?

FIGURE 6
 LIKELIHOOD OF EARLY DEATH FROM MAJOR CAUSES FOR NONWHITES COMPARED WITH WHITES,
 FEMALES COMPARED WITH MALES, AND AMERICANS COMPARED WITH SWEDES



Discussion: For each of the four major causes of early death, the likelihood of early death is higher for nonwhites than whites, males than females, and Americans than Swedes.

Sources: The data on nonwhites, whites, males, females, and Americans were calculated by the author on the basis of statistics in *Mortality Statistics 1972*, at 1-26 to 1-43. The data on Swedes were calculated by the author on the basis of statistics in *Demographic Yearbook 1975*, at 178-179 table 6 at 930 table 29.

Notes: The data are for 1972. The likelihood of early death due to some cause was calculated as the probability that a newborn child would die of that cause before age 65, at 1972 mortality rates, given that he or she would not die early from some other cause. The likelihood figures are thus "conditional likelihoods." They were calculated in this way to avoid distortions caused by the higher overall likelihood of early death among nonwhites, males, and Americans compared with whites, females, and Swedes.

III

WHY IT IS USEFUL TO DISTINGUISH BETWEEN EARLY AND LATE DEATH

The distinction between early and late death is, admittedly, an artificial one—"nature" does not divide life into two sharply-defined categories on either side of an individual's sixty-fifth birthday. Consequently, public policies designed to avert early deaths will also affect mortality among the elderly—and vice versa. This overlap, however, appears to be relatively insignificant. Public programs that would add substantial numbers of high-quality life-years to the lifespans of those currently dying early would probably add far fewer high-quality life-years to the lifespans of the elderly. And conversely, programs designed to significantly extend the lifespans of the elderly would probably have little impact on the incidence of early death. This probable lack of spill-over, which is documented below, constitutes the first major reason for distinguishing between early and late death. The second major reason, which is discussed subsequently, is that the consequences of reducing early deaths differ considerably from the consequences of extending old age.

A. The Probable Lack of Spill-Over

The typical "cause" of late death is, essentially, "old age": Even if an elderly individual is cured of some disease or saved from some accident, he or she will probably die relatively soon of some other cause. A substantial extension of life-expectancy for older people "will have to come as part of some significant medical or biological breakthrough."³⁹ Such a breakthrough is likely to be difficult to achieve, although it "can no longer be thought of as mere science fiction."⁴⁰ Furthermore, such a breakthrough would probably be fundamentally different in nature from breakthroughs in reducing early death, since it would involve:⁴¹

[A]ltering the intrinsic biological processes which are presumed to underlie aging and which seem to proceed independently from disease processes—that

39. Zeckhauser, *The Welfare Implications of the Extension of Life*, 14 GERONTOLOGIST 2, 3 (1974).

40. *Id.*

41. Neugarten, *Social Implications of a Prolonged Life-Span*, 12 GERONTOLOGIST 323, 438 (1972). The report of the Overview Cluster of the President's Biomedical Research Panel, *The Place of Biomedical Science in Medicine*, in REPORT OF THE PRESIDENT'S BIOMEDICAL RESEARCH PANEL app. A, pt. I (DHEW Pub. No. 76,501, 1976) [hereinafter cited as Report of the Overview Cluster], appears to concur with this view. The report asserts that "[h]uman beings have within reach the capacity to control or prevent human disease," *id.* at 21, but that despite "this prospect . . . [d]eath will remain as inevitable as ever, and will occur on the same sort of genetically set schedule as has been the case for healthy old people in every period of human history." *Id.* at 22. Hayflick, *The Cell Biology of Human Aging*, 295 NEW ENG. J. MED. no. 23, at 1302, 1302 (1976), reports that gerontologists have come

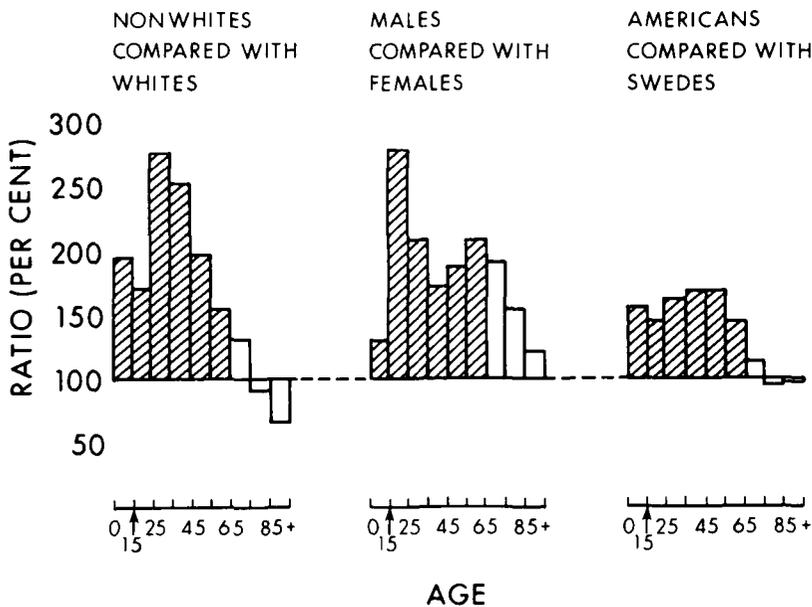
to the conclusion that the disease-oriented approach to medical research might increase life expectancy but will have very little impact on increasing the human life-span. If such an increase is desirable (and there is considerable doubt that it is), one must first separate the disease-related causes of death from the age-dependent physiologic decrements that give rise to the manifestations of old age.

is, to discover the genetic and biochemical secrets of aging, to discover the factors that underlie the rate of aging, then to alter the biological clock that is presumably programmed into the human species. This second approach is directed at rate control, rather than disease control.

This line of reasoning is indirectly supported by the data presented in Figure 7. The data indicate that the differentials between nonwhite and white, male and female, and United States and Swedish death rates tend to be greater for people under age sixty-five than they are for older people. Part of the reason for this may be that the average nonwhite, male, or American who manages to survive to old age tends to have a particularly healthy constitution. Regardless of the reason, however, the declining differentials suggest that, at least at current levels of medical and biological knowledge, more can be done about early death than about late death.

FIGURE 7

RATIOS OF AGE-SPECIFIC MORTALITY RATES FOR NONWHITES COMPARED WITH WHITES, MALES COMPARED WITH FEMALES, AND AMERICANS COMPARED WITH SWEDES



Discussion: Differentials in mortality rates tend to be greater for people under age 65 than for the elderly.

Sources: The ratios were calculated by the author on the basis of statistics (on nonwhites, whites, males, females, and Americans) in *MORTALITY STATISTICS 1972*, at I-26, I-27 table I-9; and (on Swedes) in *DEMOGRAPHIC YEARBOOK 1975*, at 678 table 26.

Note: The data are for 1972.

A similar conclusion is suggested by historical trends in United States mortality and life expectancy. The likelihood of early death declined from 61 per cent to 26 per cent in the period from 1900 to 1974; over the same period the likelihood that a person age sixty-five would die before age eighty-five, *i.e.*, the likelihood of "early late death," declined much less—from 86 per cent to 68 per cent. Similarly, while life expectancy at birth increased in this period from 47.0 years to 71.9 years, a gain of 24.9 years, life expectancy at age sixty-five only increased from 11.7 years to 15.6 years, a gain of just 3.9 years.⁴² Thus, the dramatic increase in life expectancy at birth was due to a substantial reduction in early deaths rather than a significant extension of old age.⁴³

International comparisons are also revealing. As shown in Figure 8, and as was shown earlier, there is considerable variation in early death rates among countries—and the United States does relatively poorly. There is, however, much less variation in the expected length of old age—and the United States does fairly well.⁴⁴ While the United States falls near the bottom of the list in likelihood of early death, it is tied for fifth rank in life expectancy at age sixty-five. And while the Swedish likelihood of early death is less than two-thirds of the United States level, Swedish and United States life expectancies at age sixty-five differ by just a fraction of a year.

In addition to this indirect evidence, some direct estimates can be made concerning the effect of various kinds of programs on early versus late death. In Table II, eleven hypothetical programs are considered. Some of the programs reduce various causes of death; others reduce the differentials between groups. In each case, the benefits of the programs, as measured by the number of quality-adjusted life-years gained, primarily accrue to those who would otherwise die early.

B. Differing Consequences

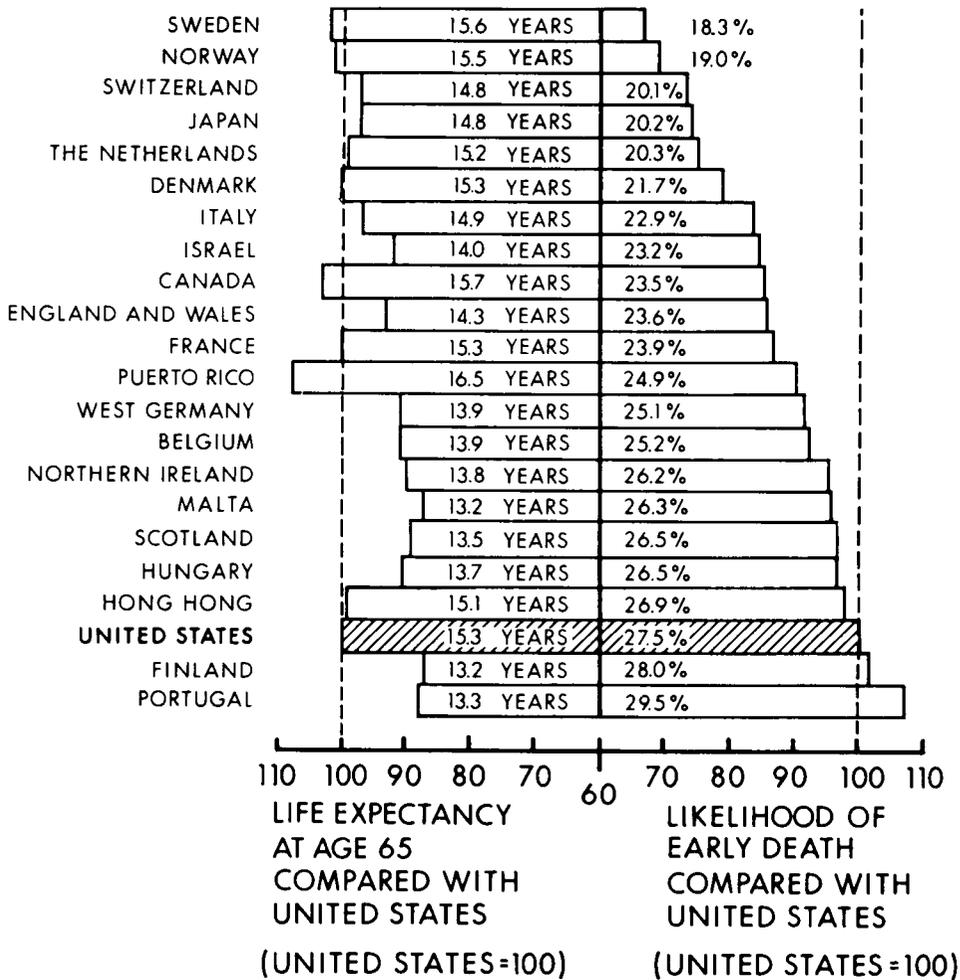
Not only do programs that would reduce early deaths differ from the programs that would extend old age, but the consequences of these two types of programs also differ.

42. The statistics in this paragraph were calculated by the author from data in *Mortality Statistics, 1974*, at 5, 8; CAUSES OF DEATH 724-27.

43. The reduction in early death was not predominantly due to reduction in infant mortality. The likelihood of death before age one decreased from 14.7 per cent in 1900 to 1.7 per cent in 1974, a reduction of 13 per cent; the likelihood of death between ages one and 65 decreased from 46.7 per cent in 1900 to 24.5 per cent in 1974, a reduction of more than 22 per cent. These statistics were calculated by the author from data in *Mortality Statistics, 1974*, at 5; CAUSES OF DEATH 724-27.

44. The statistics in Figure 8 should be interpreted cautiously, since, as mentioned earlier in the text, the individuals who manage to survive to age 65 in those countries with high early death rates may have particularly healthy constitutions. For this reason, a country that used to have a high early death rate but that has made rapid progress in health care may now have a low early death rate and an exceptionally high life expectancy above age 65. Puerto Rico may be an example of this phenomenon: In 1964, the likelihood of early death in Puerto Rico was 98 per cent of the United States level, while in 1972 it was 91 per cent, as shown in Figure 4 *supra*.

FIGURE 8
LIFE EXPECTANCY AT AGE 65 AND LIKELIHOOD OF EARLY DEATH
FOR VARIOUS COUNTRIES COMPARED WITH THE UNITED STATES



Discussion: The likelihood of early death varies substantially among countries—and the United States does relatively poorly. On the other hand, there is much less variation in the expected length of old age—and the United States does fairly well.

Source: Calculations by the author from data in DEMOGRAPHIC YEARBOOK 1975, at 644-705 table 26, 1062-1084 table 35 for early death figures; 1004-1037 table 33, table 7 156-218, for life-expectancy figures.

Notes: For the early death figures, see notes on Figure 4 *supra*. Data on life expectancy for Finland, Hong Kong, and Portugal are for 1971; for France, Hungary, Israel, Japan, the Netherlands, Sweden, and the United States, for 1972; for Belgium, for 1968-1972; for Switzerland, for 1969-1972; for Canada, England and Wales, Italy, Malta, Northern Ireland, and West Germany, for 1970-1972; for

Denmark and Norway, for 1971-1972; and for Puerto Rico and Scotland, for 1971-1973. Countries included on Figure 4, *supra*, but omitted here are those countries for which life expectancy data were not available for either 1972 or 1971 or a period of years including 1972 or 1971. For those countries for which life expectancies were only available for males and females separately, a weighted average was calculated, the weights being the male and female populations between ages 65 and 70, as given in DEMOGRAPHIC YEARBOOK 1974, at 156-218 table 7.

TABLE II
THE DISTRIBUTION, BETWEEN THE EARLY AND LATE
DEAD, OF THE BENEFITS OF VARIOUS MORTALITY CHANGES

<i>Mortality Change</i>	<i>The Benefits of Such a Change as Measured by the Number of Quality- Adjusted Life-Years That Would Be Gained per Cohort of 100,000 New Borns</i>	<i>Percentage of These Ben- efits That Would Accrue to Those Who, Under the Status Quo, Would Die Early</i>
Infant mortality:		
Cut in half . . .	62 thousand	100 per cent
Eliminated . . .	124 "	100
Death from cancer:		
Cut in half at every age . . .	73 "	77
Eliminated . . .	151 "	77
Death from cardiovascular diseases:		
Cut in half at every age . . .	143 "	62
Eliminated . . .	311 "	63
Death from accidents and homicides:		
Cut in half at every age . . .	68 "	97
Eliminated . . .	136 "	97
Nonwhite mortality rates reduced to white levels . . .	61 "	93
Male mortality rates reduced to female levels . . .	240 "	80
U.S. mortality rates reduced to Swedish levels . . .	244 "	90

Discussion: Different kinds of health and safety programs will produce different kinds of mortality changes. Eleven hypothetical kinds of mortality changes are considered in the table. In each case, the benefits, as measured by the number of quality-adjusted life-years gained, primarily accrue to those who would otherwise die early.

Source: Calculations by the author from data in *Mortality Statistics, 1974*, at 8 table 3, 12-13 table 6, and, for Sweden DEMOGRAPHIC YEARBOOK 1975, at 678 table 26.

Notes: The "quality-adjusted life-years" measure is the one described earlier: see note 11 *supra* and accompanying text. For notes on "infant mortality," "cancer," "cardiovascular diseases," and "accidents and homicides," see Figure 5 *supra*. In computing the table, it was assumed that mortality rates would continue at 1974 levels, except for the mortality changes indicated.

As discussed earlier, there is a major inequality in life-chances between the early and late dead. Programs to avert early deaths would narrow this inequality; programs to extend the life-spans of the elderly would widen it. Considerations of fairness—of helping the worse off before helping the better off—suggest that giving additional life-years to those who would otherwise die early deserves priority over giving additional life-years to those who have reached old age.⁴⁵

Beyond this, the social and economic consequences of reducing early deaths are likely to be considerably less disruptive than those of the increasing life expectancy of the elderly. As Richard Zeckhauser concluded, “extending life-spans by, say, 30 years would radically alter society and the economy . . . (in a way that) may turn out to be undesirable, indeed even disastrous, once all of its ramifications are taken into account.”⁴⁶ These radical effects would result from a substantial increase in population levels and a major shift in the age distribution of the population. For example, suppose the life expectancy of sixty-five year olds was increased by thirty years while early death rates were left unchanged. This change would increase the United States population, in the long run under one set of assumptions,⁴⁷ by 31 per cent and, as shown in Figure 9, would raise the proportion of elderly persons in the population from 16 per cent to 36 per cent.

Reducing early deaths, on the other hand, is unlikely to produce such major demographic changes. Suppose, for example, that United States mortality rates could be reduced to Swedish levels. Such a change, as indicated earlier, would cut early deaths by a third but would have little effect on mortality rates above age sixty-five. A program of this kind would increase the United States population by only about five per cent and, as shown in Figure 9, would not significantly alter the age distribution.⁴⁸ Alternatively, suppose that early death was eliminated in the United States, but that death rates above

45. As suggested by Robert Veatch (at the Conference on *Valuing Lives*, Amelia Island, Florida, March 12, 1976.)

46. Zeckhauser, *supra* note 39; for a more optimistic view, see Asimov, *The Coming Age of Age*, 3 *PRISM* 53 (1975).

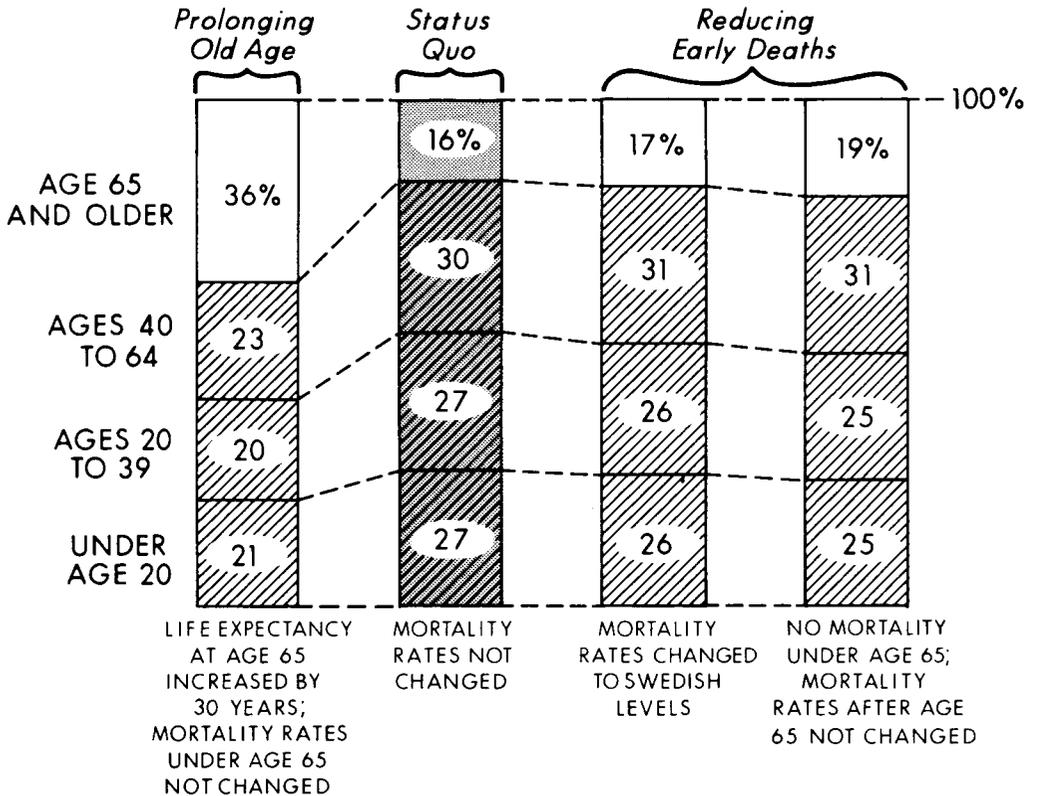
47. The figures presented in this and the following paragraphs are based on some assumptions about the United States population “in the long run.” It was assumed that in the long run the United States population would be stable, with births balancing deaths and the number of births and deaths remaining constant from year to year. In this case, the size of the population would equal the number of births per year multiplied by life expectancy in years at birth. It was further assumed that the number of births per year would be the same regardless of the pattern of mortality rates: In this case, the population size would be proportional to life expectancy. Of course, if death rates among the young were lowered, more people would reach childbearing age; on the other hand, parents might decide to have fewer children if the probability these children would die young were lowered. The calculations assume that these two effects would cancel each other out. The age-distributions shown in Figure 9 do not depend on this last assumption. See the note on Figure 9 for further explanation.

48. Under the same assumptions described in note 47 *supra*.

age sixty-five remained at current levels. A radical change of this sort would increase the United States population by about twelve per cent and, again as shown in Figure 9, would shift the age structure only slightly.⁴⁹

FIGURE 9

LONG-RUN EFFECT OF VARIOUS CHANGES IN MORTALITY RATES ON THE AGE DISTRIBUTION OF THE UNITED STATES POPULATION



Discussion: Prolonging the life-expectancy of the elderly would more than double the proportion of the population age 65 and older. On the other hand, reducing the incidence of early death by changing mortality rates to Swedish levels would have little impact on the age distribution. And even eradicating early death would have only relatively minor effects.

Source: Calculations by the author from data in *Mortality Statistics, 1974*, at 5; *DEMOGRAPHIC YEARBOOK 1975*, at 678-679 table 26.

Notes: The United States mortality rates used in calculating these figures are for 1974; the Swedish rates are for 1973. The figures are those a stable population would approach in the long run, after various transient effects have passed. The figures are based on "stationary population" figures; see 2 NAT'L CENTER FOR HEALTH STATISTICS, *VITAL STATISTICS OF THE UNITED STATES: 1971, MORTALITY PART A 5-2*, (DHEW Pub. No. (HRA) 75-1114, 1975) for a detailed explanation of them.

49. Once again, under the same assumptions described in note 47 *supra*.

In sum, it is useful to distinguish between averting early deaths and extending old age for two main reasons. The consequences differ for the distribution of life-spans, the age-distribution of the population, and the size of the population, and the nature of the appropriate programs differ. Significantly increasing the life-spans of the elderly depends on breakthroughs in altering the genetic and biochemical factors that determine aging. On the other hand, programs to reduce accidents and disease and to reduce the mortality differentials between nonwhites versus whites, males versus females and Americans versus Swedes would largely help those who would otherwise die early.

But what, more specifically, should the elements be of such programs to reduce early deaths?

IV

REDUCING EARLY DEATHS: SOME POLICY OPTIONS

There are four basic ways of attacking the early death problem: (1) improve health care delivery, (2) alter self-hazardous behavior, (3) reduce environmental hazards, and (4) strengthen biomedical research. The general nature of each of these options and the current level of public involvement are briefly surveyed below. Then, some broad conclusions are suggested.

A. Improve Health Care Delivery

Most Americans have access to adequate health care. The supply of physicians broadly matches demand; increasing the number of physicians probably would not significantly affect early death rates. The cost of medical care is high, but for most Americans affordable, at least with the help of insurance coverage and Medicare or Medicaid.⁵⁰

Although the quality and quantity of health care in the United States appears generally adequate, a number of abuses—for example, excessive surgery and excessive prescribing of drugs⁵¹—exist that need correcting. Furthermore, while some medical technologies are being over-used and driving up the costs of health care,⁵² at least one technology—mobile care units for treatment of the victims of heart attacks, accidents, and others in need of prompt medical aid—appears to be underused.⁵³

50. See V. FUCHS, *WHO SHALL LIVE?* (1974).

51. See Brody, *Incompetent Surgery is Found Not Isolated*, N.Y. Times, Jan. 27, 1976, at 1, col. 6; Rensberger, *Thousands a Year Killed by Faulty Prescriptions*, N.Y. Times, Jan. 28, 1976, at 1, col. 7.

52. See Havighurst, Blumstein, & Bovbjerg, *Strategies in the Financing of Treatment for Catastrophic Disease*, 40 LAW & CONTEMP. PROB. no. 4, at 122 (1976).

53. See J. ACTON, *EVALUATING PUBLIC PROGRAMS TO SAVE LIVES: THE CASE OF HEART ATTACKS* (1973); Thiemann, *Why the Ambulance Comes too Late*, 8 WASHINGTON MONTHLY 32 (Oct. 1976); D. Shepard, *Prediction and Incentives in Health Care Policy* (May 1976) (unpublished dissertation on file at Kennedy School of Government, Harvard University); Zeckhauser & Shepard, *supra* note 7.

In addition, nonwhites and the poor tend to receive an inferior level of health care and this may be one of the reasons for their high rate of early death.⁵⁴ The problem, in part, is affording adequate care: Expansion of current social health-care financing programs may help. A second problem is that physicians are unevenly distributed, with the urban poor and minority groups, as well as many rural areas, being underserved.⁵⁵ Various programs have been adopted to reduce this unevenness, including efforts to train more members of minority groups as physicians and the funding of health facilities in poverty areas;⁵⁶ more could be done.

B. Alter Self-Hazardous Behavior

Collectively, Americans smoke, drink, and eat too much, exercise too little, drive recklessly and while drunk, skip meals, snack on junk foods, fail to fasten seat belts, put off medical screening tests, ignore doctors' advice, neglect high blood pressure, and take too many narcotics, barbituates and other drugs. Self-hazardous behavior of this sort substantially increases the likelihood of early death. This fact, which has long been known but which recently has become so widely recognized that it may have reached the status of the "new conventional wisdom,"⁵⁷ is supported by a number of studies, including studies of the correlates of longevity.⁵⁸ Other research has demonstrated the importance of behavioral factors for each of the four major causes of death. Cardiovascular disease tends to be associated with a number of factors subject to control, including obesity, lack of exercise, excessive consumption of cholesterol, and hypertension.⁵⁹ The relationship between cancer and smoking has

54. L. ADAY & R. ANDERSEN, *ACCESS TO MEDICAL CARE* (1975), present extensive data on this, *id.* at 15-55, and review the relevant literature on race, *id.* at 105, and income, *id.* at 106. An excellent study of the inferior maternity care received by nonwhites and the poor in New York City is D. KESSNER, J. SINGER, C. KALK, & E. SCHLESINGER, *INFANT DEATH: AN ANALYSIS BY MATERNAL RISK AND HEALTH CARE* 13-18 (1973).

55. On both these problems see L. ADAY & R. ANDERSEN, *supra* note 54.

56. For a summary of this funding on the federal level, see L. RUSSELL, B. BOURQUE, D. BOURQUE, & C. BURKE, *FEDERAL HEALTH SPENDING 1969-74*, at 108-112 (1974). On October 13, 1976, President Ford "signed into law . . . a compromise \$2.1 billion health manpower bill that for the first time ties Federal Support to medical schools to the redistribution of doctors by location and choice of practice." *N.Y. Times*, Oct. 14, 1976, at 20, col. 3. At the 1976 annual meeting of the Association of American Medical Colleges it was reported that:

As recently as 1970, minority group members—black Americans, Mexican-Americans, mainland Puerto Ricans and American Indians—made up 2.8 percent of the first-year class at all medical schools. The proportion rose to 10 percent by 1974-75 and has fallen to nine percent since then [even though] the Association of American Medical Colleges set a goal in 1969 of reaching 12 percent minority enrollment in the overall freshman class by 1975-76.

N.Y. Times, Nov. 15, 1976, at 19, col. 1.

57. Schwartz, *What Strategy for Health*, *N.Y. Times*, July 27, 1976, at 29, col. 1.

58. See V. FUCHS, *supra* note 50, at 30-55; *PROMOTING HEALTH* 1-14 (A. Somers ed. 1976); M. LALONDE, *A NEW PERSPECTIVE ON THE HEALTH OF CANADIANS* (1974).

59. See Ross, *Ischemic Heart Disease—Prevention*, in *HARRISON'S PRINCIPLES OF INTERNAL MEDICINE* 1194 (7th ed. M. Wintrobe, G. Thorn, R. Adams, E. Braunwald, K. Isselbacher, & R.

been extensively documented and widely publicized.⁶⁰ Infant mortality is highly correlated with deficient prenatal care, including improper diet and use of drugs by pregnant women.⁶¹ Many accidental deaths could be averted by purchase of safety products (*e.g.*, sturdier ladders), use of safety devices (*e.g.*, seat belts and motorcycle helmets), and adoption of safer behavior (*e.g.*, using ladders more carefully and not driving after drinking.)⁶²

As part of the effort to inform Americans about how to take better care of themselves, health and safety education could be given a much more prominent role in school curricula—in elementary and secondary schools, in colleges, in adult-education programs, and in medical schools.⁶³ Knowledge of the basis of health and of why certain kinds of behavior may considerably shorten life-spans is surely as interesting and as important as knowledge of history, physics, or French.

Many unhealthy activities—including smoking, excessive drinking, reckless driving, overeating, and lack of exercise—are habits formed in a person's youth. As William James has written: "Could the young but realize how soon they will become mere walking bundles of habits, they would give more heed to their conduct while in the plastic state."⁶⁴ Since habits are extraordinarily difficult to change, the best hope for reducing unhealthy and unsafe behavior may be to try to inform the young while they are "in the plastic state."

That habits are difficult to change is illustrated by the lack of success of programs to reduce smoking, drinking, and drunken driving. The Surgeon General's warning on cigarette packs seems to have little effect; laws against drunken driving are widely violated. But more could be done and other types of programs could be tried. Cigarette smoking, for example, might be reduced if cigarette taxes were substantially increased, if cigarette advertising were banned, if areas where smoking was permitted were severely limited,

Petersdorf 1974); Podell, *The Prevention of Atherosclerotic Heart Disease*, in *PROMOTING HEALTH*, *supra* note 58, at 177.

60. The first major report on the subject was U.S. DEPT OF HEALTH, EDUCATION, AND WELFARE, *SMOKING AND HEALTH: REPORT OF THE ADVISORY COMM. TO THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE* (Pub. Health Service Doc. No. 1103, 1964). The Nationwide Clearinghouse for Smoking and Health publishes an annual review of worldwide medical literature on the relation of smoking and disease as well as an annual collection of brief descriptions of on-going research pertaining to smoking and health. *See, e.g.*, U.S. PUB. HEALTH SERVICE, *HEALTH CONSEQUENCES OF SMOKING, 1975* (DHEW Pub. No. 76-8704, 1976); U.S. DEPT OF HEALTH, EDUCATION, AND WELFARE, *1976 DIRECTORY OF ON-GOING RESEARCH IN SMOKING AND HEALTH* (1976).

61. *See* D. KESSNER, J. SINGER, C. KALK, & E. SCHLESINGER, *supra* note 54; R. GLASSER, *THE GREATEST BATTLE* 45-74 (1976).

62. *See* W. LOWRANCE, *OF ACCEPTABLE RISK* 128-54 (1976).

63. On health education see *PROMOTING HEALTH*, *supra* note 58. W. LOWRANCE, *supra* note 62, at 149, briefly discusses safety education. A well-done "consumer's guide to medical care" is D. VICKERY & J. FRIES, *TAKE CARE OF YOURSELF* (1976); a second excellent guide is K. SCHNERT, *HOW TO BE YOUR OWN DOCTOR (SOMETIMES)* (1975).

64. James, *Habit*, in *THE WRITINGS OF WILLIAM JAMES* 20 (J. McDermott ed. 1968).

or if even greater efforts were made to inform the public of the dangers.⁶⁵ Stricter penalties and stricter enforcement might decrease drunken driving.⁶⁶ On the other hand, suitable incentive programs—*e.g.*, to lose weight, to exercise, or to reduce cigarette smoking—may prove more effective than penalties, sanctions, and prohibitions.⁶⁷ Much research remains to be done here.⁶⁸

Relatively little is currently being done to alter self-hazardous behavior through education. According to one set of estimates, total expenditures on health education are currently in the range of \$250 to \$500 million per year—well under one per cent of current total health expenditures of roughly \$130 billion per year.⁶⁹ These educational expenditures amount to only about a dollar or two per year per person. Furthermore, the quality of health education efforts is generally poor. Often, in public schools, health education “is merely a substitute for gym on a rainy day.”⁷⁰ A recent federal initiative, the National Consumer Health Information and Health Promotion Act of 1976, is supposed to provide for a national program of “health information, health promotion, preventive health services, and education in the appropriate use of health care”⁷¹—but the funds authorized for the new Office of Health Information and Health Promotion to implement this program amount to only \$7 million for fiscal year 1977, \$10 million for 1978, and \$14 million for 1979.⁷²

Although enough is currently known about the impact of personal behavior on health to justify efforts to develop more effective health and safety education and incentive programs, more research still needs to be done on what individuals can do to take better care of themselves.⁷³ As discussed above, there is considerable evidence that personal behavior influences mor-

65. For an international survey of recent findings and current research on the effectiveness of antismoking programs, see indexed listing in ON-GOING RESEARCH ON SMOKING AND HEALTH, *supra* note 60, at 379.

66. See Ross, *Law, Science, and Accidents: The British Road Safety Act of 1967*, 2 J. LEGAL STUD. 1 (1973). Ross's careful and thorough analysis “suggests that the principles inherent in the British legislation of 1967 retain their potential if not necessarily their effectiveness. If the legitimate objections of the police which restrict enforcement to sub-optimal levels can be overcome, renewed savings in casualties can be expected.” *Id.* at 78. See also Ross & Blumenthal, *Sanctions for the Drinking Driver: An Experimental Study*, 3 J. LEGAL STUD. 53 (1974).

67. See D. Shepard, *supra* note 53. A partial summary of some of Shepard's research is included in Zeckhauser & Shepard, *supra* note 7.

68. U.S. DEP'T OF HEALTH, EDUCATION, AND WELFARE, FORWARD PLAN FOR HEALTH: FY 1977-81, at 99-117 (DHEW Pub. No. 76-50024, 1975) includes an extensive list of policy options for preventable health problems.

69. PROMOTING HEALTH, *supra* note 58, at 46-50, 2.

70. *Id.* at 22.

71. Title I of Pub. L. No. 94-317, § 102, 90 Stat. 695 (1976), which was signed into law by President Ford on June 23, 1976; PROMOTING HEALTH, *supra* note 58, at xix.

72. PROMOTING HEALTH, *supra* note 58, at xxi.

73. Report of the Overview Cluster at 3. The report concluded: “The relationship between one's personal habits . . . and physical health is . . . a problem badly in need of scientific study.”

tality: The quantitative importance, however, of even such major factors as “regular exercise, improved eating habits, sleep, abstinence from smoking, and temperance in alcohol” is not precisely known.⁷⁴ Errors in attributing ill-health effects to various foods and activities may result in needless reductions of pleasure. Such an error may have been made regarding cholesterol—some recent studies indicate that consumption of cholesterol has little impact on health.⁷⁵ Straightening out what is healthy, what is unhealthy, and what does not make much difference, would not only result in increased life but would also considerably improve the quality of life and reduce anxiety.

C. Reduce Environmental Hazards

Various “environmental” factors cause early deaths, especially from cancer, accidents, and homicide. Most cancer appears to be caused by exposure to radiation and various carcinogens;⁷⁶ many accidents result from unsafe products or hazardous behavior by others (*e.g.*, drunken driving). A number of federal agencies are working to reduce environmental hazards—a partial listing is given in Table III.

TABLE III
PARTIAL LISTING OF FEDERAL AGENCIES
WORKING TO REDUCE
ENVIRONMENTAL HEALTH AND SAFETY HAZARDS

Department of Health, Education, and Welfare
*The Food and Drug Administration
—Bureau of Drugs
—Bureau of Foods
—Bureau of Radiological Health
—National Center for Toxicological Research
*The National Institutes of Health
—National Cancer Institute
—National Institute of Environment Health Sciences
—National Institute of General Medical Sciences
—National Library of Medicine

74. *Id.* at 14.

75. See Altschule, *Is It True What They Say About Cholesterol*, 12 EXECUTIVE HEALTH no. 11, at — (1976); Rhoads, Gulbrandsen, & Kagan, *Serum Lipoproteins and Coronary Heart Disease in a Population Study of Hawaii Japanese Men*, NEW ENG. J. MED. 293 (1976); *Prevention of Coronary Heart Disease*, 10 J. ROYAL C. PHYSICIANS OF LONDON, no. 3, at 213 (1976).

76. A recent article, Cairns, *The Cancer Problem*, 233 SCIENTIFIC AM. 64 (Nov. 1975) was subtitled as follows: “Almost all cancers appear to be caused by exposure to factors in the environment. The most promising approach to the control of the disease is to identify those factors and eliminate them.” *Id.* at 64. The article reports:

If by the appropriate public-health measures the incidence of each kind of cancer could be reduced to the lowest level observed anywhere in the world, the overall incidence of cancer would be reduced at least tenfold. That is roughly equivalent to the reduction in mortality from infectious diseases that has been achieved in the past 50 years.

Id. at 70.

- *The Center for Disease Control
 - Bureau of State Services
 - National Institute for Occupational Safety and Health
- *The Alcohol, Drug Abuse, and Mental Health Administration
- Department of Agriculture
 - *Animal and Plant Health Inspection Service
 - *Agricultural Research Service
- Department of Commerce
 - *National Bureau of Standards
 - *Office of Product Standards
- Department of Defense
 - *Office of Health and Environment
- Department of Interior
 - *United States Fish and Wildlife Service
 - *Bureau of Mines
 - *Mining Enforcement and Safety Administration
 - *Bureau of Indian Affairs
- Department of Housing and Urban Development
 - *Office of Environmental Quality
- Department of Justice
 - *Drug Enforcement Administration
 - *Law Enforcement Assistance Administration
- Department of Labor
 - *Occupational Safety and Health Administration
- Department of Transportation
 - *Federal Aviation Administration
 - *Federal Highway Administration
 - *National Highway Traffic Safety Administration
 - *Federal Railroad Administration
 - *United States Coast Guard
- Department of the Treasury
 - *Bureau of Alcohol, Tobacco and Firearms
- Other Major Agencies
 - *Civil Aeronautics Board
 - *Consumer Product Safety Commission
 - *Energy Research and Development Administration
 - *Environmental Protection Agency
 - *Federal Power Commission
 - *Federal Trade Commission
 - Bureau of Consumer Protection
 - *General Services Administration
 - Consumer Protection Information Center
 - *Interstate Commerce Commission
 - *National Aeronautics and Space Administration
 - *National Science Foundation
 - *National Transportation Safety Board
 - Bureau of Aviation Safety
 - Bureau of Surface Transportation Safety
 - *Nuclear Regulatory Commission
 - *Occupational Health and Safety Review Commission
- Various Councils, Committees and Quasi-official Agencies
 - *Federal Fire Council
 - *Federal Safety Advisory Council

- *National Advisory Committee on Occupation Safety and Health
- *National Academy of Sciences
- *Institute of Medicine

Source: Compiled by author from information in U.S. DEP'T OF HEALTH, EDUCATION, AND WELFARE, REPORT OF THE PRESIDENT'S BIOMEDICAL RESEARCH PANEL 103-108 app. D (DHEW Pub. No. 76-504, 1976); OFFICE OF THE FEDERAL REGISTER, GENERAL SERVICES ADMINISTRATION, UNITED STATES GOVERNMENT MANUAL 1975-1976 (1975).

Collectively these various agencies are estimated to have spent more than \$800 million in 1974 on environmental health and safety.⁷⁷ The range of their activity is suggested by the spate of recent newspaper stories about them,⁷⁸ but these stories only report a fraction of their activity. At the end of 1974, the safety standards issued by one of these agencies, the Occupational Safety and Health Administration," cover 800 pages in the Code of Federal Regulations and number close to 4,400;" these standards included more than 140 regulations governing the use and construction of portable wood ladders.⁷⁹

The regulatory agencies have been widely criticized, on the one hand, for adopting policies that produce little reduction in mortality or morbidity at great cost in money or in restriction of individual liberty, and, on the other hand, for worrying too much about costs and the interests of businesses and not enough about lifesaving.⁸⁰ The virtually incomprehensible language in

77. This estimate is found in U.S. DEP'T OF HEALTH, EDUCATION, AND WELFARE, REPORT OF THE PRESIDENT'S BIOMEDICAL RESEARCH PANEL 103-08 app. D (DHEW Pub. No. 76-504, 1976).

78. Some recent newspaper reports of federal regulation of environmental health and safety hazards are: *Consumer Agency Warns of Sales of Candles With Lead-Core Wicks*, N.Y. Times, Dec. 14, 1976, at 14, col. 2; *Coleman Decides Against Air Bags for New Autos*, Wall St. J., Dec. 7, 1976, at 3, col. 1; *U.S. Agency Postpones Air-Brake Standard for Buses to Sept. 1*, Wall St. J., Nov. 29, 1976, at 3, col. 5; *EPA Sets Rules on Air Emissions of Vinyl Chloride*, Wall St. J. Oct. 22, 1976, at 2, col. 2; *Agency Refuses to Recall Certain Smoke Detectors*, Wall St. J., Sept. 29, 1976, at 10, col. 2 ("The Nuclear Regulatory Commission said it won't ban and recall 4.2 million smoke detectors containing radioactive metal."); *House Votes Ban on Output of PCB's Within 3 Years*, N.Y. Times, Aug. 24, 1976, at 1, col. 2; *Tarantulas are Eluding Federal Regulatory Web*, N.Y. Times, Aug. 9, 1976, at 25, col. 1; *Chloroform Ban Has a Weak Spot*, N.Y. Times, July 14, 1976, at 46, col. 1; *FDA Refuses to Lift '69 Cyclamate Ban Because of Unanswered Questions About Safety*, N.Y. Times, May 12, 1976, at 16, col. 1; *A Recall Is Sought On Infant Pacifiers After Baby's Death*, N.Y. Times, March 6, 1976, at 29, col. 6; *A Ban on Most Pesticides With Mercury is Ordered*, N.Y. Times, Feb. 19, 1976, at 1, col. 1; *Rules for Glass and Plastic Doors, Panels Are Proposed by Product Safety Agency*, Wall St. J., Feb. 12, 1976, at 5, col. 1; *Railings Soon To Be Installed*, Duke Chronicle, Jan. 27, 1976, at 3, col. 6 ("According to regulations set by OSHA, all stairs, whether internal or external, having more than four risers must provide hand rails."); *FDA Moves to Ban DES in Animal Feed Due to Cancer Link*, Wall St. J., Jan. 12, 1976, at 5, col. 4; *E.P.A. Proposes Rules to Cut a Cancer-Causing Gas by 90%*, N.Y. Times, Dec. 17, 1975, at 22, col. 3; *Product Safety Agency Issues Swimming Pool Slide Standard*, N.Y. Times, Sept. 27, 1975, at 18, col. 4.

79. R. SMITH, THE OCCUPATIONAL SAFETY AND HEALTH ACT 11 (1976).

80. Some recent critical articles and newspaper stories include: Baram, *Regulation of Environmental Carcinogens: Why Cost-Benefit Analysis May Be Harmful to Your Health*, 78 TECHNOLOGY REV.

which the regulations of these agencies are issued often leads one to question the quality of the analysis underlying the regulations⁸¹—and closer scrutiny does indeed reveal major theoretical and empirical shortcomings. The most important of these problems involve developing valid measures of the “monetary value of a life”⁸² and the “liberty value of a life,”⁸³ and accurately predicting effects of lifesaving programs on mortality.⁸⁴ It seems clear that further research in these areas will significantly enhance the quality of the analytical basis of health and safety regulation.

In addition to improving current regulatory efforts to limit toxic substances and carcinogens and to enhance product and occupational safety, deaths due to environmental hazards might be reduced in a number of other ways. The federal government funds some research on developing safer prod-

no. 8, at 40 (1976); *Reactor Engineer Says Nuclear Agency Violated Public's Trust on Safety*, N.Y. Times, Dec. 14, 1976, at 21, col. 1; *The Visible Hand*, N.Y. Times, Dec. 2, 1976, at 43, col. 5 (“The Government does too much, and it does too little.”); *Safety-and-Health Agency in Cross Fire*, Christian Sci. Monitor, Oct. 26, 1976, at 14, col. 1; Wicker, *The Most Pervasive Corruption*, N.Y. Times, Oct. 19, 1976, at 39, col. 1 (“[T]he National Transportation Safety Board is investigating an outrageous decision by the Federal Aviation Agency to postpone for a year—until Dec. 31, 1978—the deadline for commercial airlines to make vital safety modifications in their jumbo jets.”); *8 Consumer Groups Charge Ford With Endangering Public Safety*, N.Y. Times, Sept. 23, 1976, at 26, col. 1; *Industry Scores U.S. Version of Whitefish*, N.Y. Times, Aug. 20, 1976, at B1, col. 1; *Lax Protector?*, Wall St. J., Aug. 13, 1976, at 1, col. 5; *Matchless Regulators*, Christian Sci. Monitor, Aug. 19, 1976, at 32, col. 3 (“Of course, there is a need for government watchdogs to protect the safety of consumers. But such bureaucrats ordinarily love the power to regulate the lives of their compatriots and are imaginative in inventing ways to do so.”); *Delay on Air Bag Draws Nader Ire*, N.Y. Times, Aug. 4, 1976, at 68, col. 1; *Big Government—Too Much Regulating?*, Christian Sci. Monitor, May 28, 1976, at 14, col. 1; *F.D.A. Called Lax on Cancer Peril*, N.Y. Times, March 16, 1976, at 15, col. 1; Kristol, *Notes on the Spirit of '76*, Wall St. J., April 23, 1976, at 10, col. 4 (“Fireworks are now illegal in many parts of the country, and a federal agency with the acronym OSHA—it prevents consenting adults from doing unsafe things to one another, unless they are immoral or subversive, in which case they are protected by the Constitution—has already announced that, beginning next year, all fireworks except teeny-weeny squibs will be prohibited.”); *A Cool Look at OSHA*, Wall St. J., March 8, 1976, at 10, col. 1 (“Of all the new rules imposed on business by Congress in its 1970 fit of environmental regulation, the ones that seemingly have caused the most annoyance are those in OSHA, the Occupational Safety and Health Act.”); Boffey, *Death of a Dye?*, N.Y. Times, Feb. 29, 1976, § 6 (Magazine), at 9 (“Red No. 2, a food coloring consumed daily by millions of Americans, was tested time and again for safety. Yet now, nearly a century after its introduction, the Government's top regulatory officials have concluded that its safety remains uncertain.”); Walters, *You Deserve a Better Chance of Surviving an Air Crash*, Parade, Feb. 1, 1976, at 4; *Regulatory Agencies Target of Criticism*, Christian Sci. Monitor, May 28, 1976, at 17, col. 3; *Federal Agency Rules Coming Under Fire*, Christian Sci. Monitor, Nov. 21, 1975, at 22, col. 1.

81. One of the standards for portable wood ladders, found in 29 CFR § 1910.25(b)(3)(ii), is:

The general slope of grain and that in areas of local deviations of grain shall not be steeper than 1 in 15 in rungs and cleats. For all ladders cross grain not steeper than 1 in 12 are permitted in lieu of 1 in 15, provided the size is increased to afford at least 15 percent greater calculated strength for ladders built to minimum dimensions. Local deviations of grain associated with otherwise permissible irregularities are permitted.

For further criticism of the language of regulation, see M. WEIDENBAUM, *GOVERNMENT-MANDATED PRICE INCREASES* (1975).

82. See Acton, *supra* note 13.

83. That is, how much liberty should we sacrifice to avert deaths.

84. See Zeckhauser & Shepard, *supra* note 7.

ucts, including a program to design a "safety car" suitable for mass production.⁸⁵ The level of this funding could be increased. Drunken drivers are implicated in many motor vehicle accidents. As discussed earlier, the incidence of drunken driving might be reduced by appropriate education programs, by increasing the probability of arrest and conviction, or by increasing the penalties.⁸⁶ Some reduction in homicides might follow from reinstatement of the death penalty or from controls on the sale and possession of firearms.⁸⁷

D. Expand Biomedical Research

In the twenty years from 1955 through 1974, federal government funding of health research increased twenty fold—from \$139 million to \$2.8 billion per year. Total public and private funding of health research increased almost as rapidly, from \$261 million in 1955 to \$4.3 billion in 1974.⁸⁸

At least partly as a result of this effort, biomedical research may be on the verge of major breakthroughs in understanding cancer, cardiovascular disease, and other deadly illnesses. A recent review of the state of biomedical science concluded that "human beings have within reach the capacity to control or prevent human disease."⁸⁹ The study reports that "there do not appear to be any impenetrable, incomprehensible diseases" and that this represents a major advance that has occurred only in the past quarter century.⁹⁰ To speed the achievement of these breakthroughs, the study recommends increasing expenditure on biomedical research from its current level of four per cent to a level of five per cent of total health expenditures. According to a recent report, however, "The Office of Management and Budget estimates that federal expenditures for health-related research will total just over \$2.5 billion in FY 1976, down from the \$2.6 billion estimate for FY 1975, and the \$2.8 billion outlay for FY 1974."⁹¹

85. It was reported that on October 12, 1976, "Secretary of Transportation William T. Coleman Jr. unveiled today two experimental automobiles . . . the two mock-up cars were products of the multimillion-dollar Government program to design a production-ready safety car for the 1980's that private industry would then take over." N.Y. Times, Oct. 13, 1976, at 18, col. 6.

86. See Ross, *supra* note 66.

87. On the death penalty, see Ehrlich, *The Deterrent Effect of Capital Punishment: A Question of Life and Death*, 65 AM. ECON. REV. 397 (1975); on gun control, see G. NEWTON, JR. & F. ZIMRING, *FIREARMS AND VIOLENCE IN AMERICAN LIFE* ch. 7 (1969).

88. The statistics in this paragraph are from NAT'L INSTITUTE OF HEALTH, *BASIC DATA RELATING TO THE NAT'L INSTITUTES OF HEALTH*, 1975, at 5 (1975). Considerably lower figures for R & D expenditures in 1974 are reported in Mueller & Gibson, *National Health Expenditures, Fiscal Year 1975*, 39 SOC. SECURITY BULL. 3, 2 table 7 (1976). They give a figure of \$2.2 billion for federal health research expenditures and a figure of \$2.4 billion for total public and private expenditures. But as they indicate, "research expenditures of drug companies in 'drugs and sundries' are excluded from 'research expenditures.'" *Id.* at 7 n.2. This may explain much of the discrepancy.

89. Report of the Overview Cluster 21.

90. *Id.* at 22.

91. FORWARD PLAN FOR HEALTH, *supra* note 68, at 62.

E. Some Pessimism—and Some Optimism

None of the various options adumbrated above is certain to reduce significantly the incidence of early death. More precisely, it is impossible to predict, on the basis of what is currently known, how many early deaths could be averted by spending x dollars on program y . There is some evidence that “the production function for direct health care (hospitals, doctors, drugs) is horizontal . . . in the relevant range” so that increasing “the provision of direct health services [will have] no measurable effect on the health of the population.”⁹² Attempts to reduce self-hazardous behavior have met little success. Even a vastly expanded program of education, penalties, and incentives may have only marginal impact—and to the extent such programs infringe on individual liberty they may be unacceptable. Some of the efforts to date to limit carcinogens and to improve product and occupational safety have proven extremely expensive, costing millions of dollars per death averted.⁹³ The United States may not be able to afford to save many lives in this way. Policemen and judges may be unwilling to enforce laws against drunken driving.⁹⁴ Safer cars may encourage driving so recklessly as to counterbalance the safety gains.⁹⁵ Gun control may be politically infeasible, unworkable, or offset by increased stabbings, bludgeonings, and poisonings. The constraint on biomedical breakthroughs may be time, rather than money. Nobel laureate James D. Watson, for example, speculated that “we may easily have twenty-five to fifty years ahead of us as pure scientists before we can precisely say, for example, why a cell has become leukemic.”⁹⁶

In short, although four broadly different kinds of approaches to reducing early death—and scores of different programs within each approach—can be described, the available evidence is so meager and contradictory that none of the programs can be identified as certain of success. Indeed, a judicious observer might well bet against each of the programs. This, however, is no reason to neglect early death, no reason for inaction.

First, even if the chances are against each of the programs, some of them might work if a number of them are tried. “Murphy’s law” states that if something can go wrong, it will. But the obverse is equally valid: If something can go right, it will.

92. Neuhauser, *The Future of Proprietaries in American Health Services*, in *REGULATING HEALTH FACILITIES CONSTRUCTION* 233 (C. Havighurst ed. 1974).

93. According to a recent article, *Placing Dollar-and-Cent Value on Life*, *Washington Post*, Nov. 29, 1976, at A1, col. 1, OSHA “is requiring steel companies to install engineering devices and adopt work practices that will control the coke fumes . . . the Council on Wage and Price Stability . . . called the regulations inflationary. They would cost \$4.5 million for each life saved, the Council said.” See also *Coke-Oven Emission Rules are Opposed by Wage-Price Council Because of Costs*, *Wall St. J.*, May 12, 1976, at 4, col. 2.

94. See Ross, *supra* note 66.

95. Peltzman, *The Effects of Automobile Safety Regulation*, 83 *J. POL. ECON.* 677 (1975).

96. J. HIXSON, *THE PATCHWORK MOUSE* 173 (1976).

Some simple probability calculations provide a suggestive illustration of this "law." Suppose ten independent programs exist, each of which has one chance in five of saving a thousand lives—and four chances in five of saving none. The odds are small that any particular program will succeed and the chances are miniscule—less than one in ten million—that all ten will succeed. The probability, however, that at least one of the programs will succeed is high—nearly 90 per cent—and the package of ten programs can be expected to save some thousand lives.

The design of a strategy for reducing early death is clearly a vast undertaking, enormously more complicated than assembling ten programs that each have one chance in five of saving a thousand lives. But the example is suggestive⁹⁷ and it does seem likely, given the fog of uncertainty that envelops decisionmaking here, that the optimal strategy would be to keep our options open and spread our bets. Such a strategy might indeed result in a significant reduction in early deaths.

The data presented earlier—on differentials in early death rates between nonwhites versus whites, males versus females, and the United States versus other industrialized countries and on the long-term downward trend in early death rates—provide a second reason for suspecting that substantial progress could indeed be made. Although the differentials and the downward trend may be due to "climate" or "genetics" or other factors largely beyond our control,⁹⁸ it does seem plausible that factors that can be affected by public policies such as health care, bad habits, and pollution levels, play a major role.

Since relatively little is known about the causes of the differentials and the downward trend,⁹⁹ a modest investment in research here—a few million dollars a year, say, some one per cent of one per cent of our total annual health expenditures of well over \$100 billion—may well yield major advances. As an example of the insights that can follow from some simple research along these lines, consider Tables IV and V.

A third major reason why it is worth considering what can be done about early death is simply this: If early deaths could be significantly reduced, the benefits would be enormous. Even if the chances were only one in four, say, or one in ten, the benefits of success would be so sizeable that it would be worth risking, if necessary, scores of billions of dollars in the attempt.

97. More complicated and realistic analogies can be constructed. As a step in this direction, one might consider ten independent programs, the number of lives that might be saved by each being distributed, say, log-normally. Then it can be shown that the expected value of the number of lives saved by a package of all ten programs will be greater than the sum of the most likely (modal) number of lives that would be saved by each program. R. Behn & J. Vaupel, *The Analytical Basis of Murphy's Wisdom* (in preparation) (unpublished working paper, on file at Institute of Policy Sciences and Public Affairs, Duke University).

98. But unlikely given United States ranks below both colder and warmer countries and the countries from which the vast bulk of our (white) immigrants' ancestors came.

99. The modest level of knowledge here is indicated by the kind of facts presented and references cited in this article.

TABLE IV
COMPARISON OF
NONWHITE AND WHITE EARLY DEATH RATES
FOR VARIOUS CAUSES OF DEATH

<i>Cause of Death</i>	<i>Likelihood of Early Death from This Cause for Nonwhites as a Multiple of the Likelihood for Whites</i>	<i>Excess Nonwhite Deaths from This Cause, per 100,000 Births</i>	
		<i>Number</i>	<i>Cumulative Percentage</i>
Homicide	8.9	2760	(14.6%)
Hypertension	7.4	370	(16.6)
Nutritional Deficiencies	6.8	100	(17.1)
Hypertensive Heart Disease	5.9	460	(19.6)
Tuberculosis	5.4	290	(21.1)
Anemias	5.0	140	(21.9)
Nephritis and Nephrosis	4.8	440	(24.2)
Complications of Pregnancy	4.1	50	(24.5)
Kidney Infections	3.8	150	(25.3)
Meningitis	3.6	50	(25.5)
Septicemia	3.5	120	(26.2)
Diabetes Mellitus	3.1	920	(31.1)
Cerebrovascular Diseases	2.9	2770	(45.8)
Influenza and Pneumonia	2.5	850	(50.3)
Appendicitis	2.4	30	(50.4)
Other Infective and Parasitic Diseases	2.4	110	(51.0)
Hernia and Intestinal Obstruction	2.0	70	(51.4)
Infant Mortality	2.0	1550	(59.6)
Cirrhosis of Liver	1.9	920	(64.5)
Accidents, other than Motor Vehicle Accidents	1.8	1000	(69.8)
Peptic Ulcer	1.7	80	(70.2)
Heart Disease, other than Hypertensive Heart Disease	1.4	3600	(89.3)
Malignant Neoplasms ("Cancer")	1.3	2020	(100.1)
Motor Vehicle Accidents ▲	1.2	370	(102.0)
Suicide	0.57	-380	(100.0)
All Causes	1.61	15630	—

Discussion: Nonwhites are about 1.6 times more likely to die early than whites. But there is considerable variation in the relative likelihood of early death from various causes. The range extends from homicide to suicide: nonwhites are a shocking 8.9 times more likely to be murdered than whites, but only 57 per cent as likely to take their own lives. More than half of excess nonwhite early deaths—i.e., those deaths that would not occur if nonwhite mortality rates were reduced to white levels—are due to those causes that kill nonwhites at least two and a half times more frequently than whites. For three causes of death that have received great attention—heart disease, cancer, and motor vehicle accidents—the differential between nonwhites and whites is relatively low: eliminating these three differentials would reduce excess nonwhite deaths by less than a third.

Source: Calculations by the author from data in MORTALITY STATISTICS 1972, at 1-26 to 1-43 tables 1-9.

Notes: "Infant mortality" includes all deaths of individuals under age 1; such deaths are not included in the other categories.

The likelihood of early death from some cause was calculated as the proportion of a cohort of newborns who would die before age 65 from that cause, at 1972 mortality rates, given that they did not die from some other cause. (See notes on Figure 6 *supra* for further discussion of this.) Consequently, the sum of the figures in the second column of the table is not 15,630: the sum turns out to be 18,840. The cumulative percentages in the third column of the table were calculated using this figure as the denominator.

TABLE V

THE RATIO OF NONWHITE TO WHITE EARLY DEATH RATES COMPARED
WITH A MEASURE OF WHITE PROGRESS AGAINST EARLY DEATH,
FOR VARIOUS CAUSES OF DEATH

Cause of Death	Likelihood of Early Death from This Cause for Nonwhites as a Multiple of the Likelihood for Whites, at 1972 Mortality Rates		Likelihood of Early Death from This Cause for Whites at 1940 Mortality Rates as a Multiple of the Likelihood for Whites at 1972 Mortality Rates	
	Value	(Rank)	Value	(Rank)
Homicide	8.9	(1)	0.61	(14)
Tuberculosis	5.4	(2)	35.6	(1)
Nephritis and Nephrosis	4.8	(3)	20.8	(3)
Diabetes Mellitus	3.1	(4)	2.7	(8)
Influenza and Pneumonia	2.5	(5)	3.5	(5)
Appendicitis	2.4	(6)	30.9	(2)
Hernia and Intestinal Obstruction	2.0	(7)	5.6	(4)
Infant Mortality	2.0	(8)	3.2	(7)
Cirrhosis of Liver	1.9	(9)	0.5	(15)
Accidents, other than Motor Vehicle Accidents	1.8	(10)	1.6	(9)
Cardiovascular Disease	1.7	(11)	1.3	(10)
Peptic Ulcer	1.7	(12)	3.5	(6)
Malignant Neoplasms (Cancer)	1.3	(13)	0.9	(13)
Motor Vehicle Accidents	1.2	(14)	1.0	(12)
Suicide	0.57	(15)	1.2	(11)

Discussion: The data on the likelihood of early death from various causes for nonwhites relative to whites seem to be consistent with a simple hypothesis: nonwhites die relatively most frequently from those causes against which the greatest gains have been achieved over the last few decades, at least for whites. The table tests this hypothesis in terms of a simple measure of this progress—the likelihood of early death for whites in 1940 relative to 1972. With the exception of “homicide”, a strong correlation is evident. Indeed, if the homicide category is omitted, the Spearman Rank Correlation Coefficient has a value of 0.8. It seems clear that the health care of nonwhites lags behind that of whites, perhaps because nonwhites are ill-informed of proper personal health care, cannot afford adequate medical care, or are provided with inferior medical care. This suggests programs designed to increase the quality of health knowledge and health care among nonwhites—as well as programs to decrease the outrageous homicide rate—might significantly reduce the egregious differential between nonwhites' and whites' life-chances.

Source: Calculations by the author from data in MORTALITY STATISTICS 1972, at 1-26 to 1-43; U.S. DEPT OF HEALTH, EDUCATION, AND WELFARE, VITAL STATISTICS OF THE UNITED STATES, 1940-1960, at 374-542 table 63 (Public Health Service Pub. No. 1677, 1968).

Notes: The notes for Table IV also apply to this table. The causes of death listed in the table are those for which data were available for both 1940 and 1972.

How sizable would the benefits be? A precise estimate is not needed to make the point: The benefits—of averting some or perhaps most of the 700,000 early deaths that we suffer every year and of reducing the inequality in life-chances between the early and late dead—are clearly large enough to justify directing considerable attention toward figuring out how. Nonetheless, the analysis, presented below, of the value of the benefits, simplified and broad-brushed as it is, may be of some use in reinforcing this conclusion.

V

THE MAGNITUDE OF THE BENEFITS OF AVERTING EARLY DEATHS

A. What Should the Present Give the Future?

By improving current health and safety programs, the United States might be able to reduce the incidence of early death by 10 or 20 per cent over the next decade or so. Drastic reductions in early death, reductions, say, to 10 or 20 per cent of current levels, on the other hand, depend on new knowledge gained through biomedical, behavioral, environmental, and cross-national research and on altering hazardous behavior through health and safety education and incentive programs. Consequently, such gains may take twenty or thirty years or even longer.¹⁰⁰

How much is it worth spending to get benefits, even the enormous benefits of virtually eliminating early death, thirty years from now? Thirty years is only a generation away and most of the people currently alive in the United States will still be alive then. For an historian, thirty years is a short interval; for an archaeologist, a moment; and for a cosmologist, a negligible instant. For many politicians, economists, policy analysts, businessmen, and taxpayers, however, thirty years seems long-run. If calculated in terms of "discounted present-value," large benefits would be required in thirty years to justify an investment today. At a ten per cent discount rate—the rate suggested by the Office of Management and Budget for evaluation of governmental programs¹⁰¹—future benefits would have to be more than seventeen times present costs.¹⁰² When viewed from this perspective, it may not be intuitively clear that gradual progress against early death is worth large current expenditures; some calculations are needed.

Before presenting these calculations, it will be helpful to examine the question from a different perspective. An investment now to achieve future benefits represents a gift from the present to the future. As with any gift, in

100. A health course taken by a fifteen-year-old might not "save" his or her life until thirty years later.

101. OFFICE OF MANAGEMENT AND BUDGET, CIR. NO. A-94 (March 27, 1972). For a recent survey of discounting, see R. SHISHKO, CHOOSING THE DISCOUNT RATE FOR DEFENSE DECISION-MAKING (Rand Corp. Rep. No. R-1953-RC, 1976).

102. 1.10 raised to the 30th power is about 17.45.

deciding what to give, the tastes of the recipients should be taken into account. Assuming that economic growth continues, the members of the future will be considerably richer than we are, and consequently likely to put an even higher value on the reduction of early death than we do. Their money will buy them things we cannot afford, but it probably will not enable them to change drastically the effects of their education (and habits), or to move very far beyond the base of health and safety knowledge we develop, since research requires not only money but time. Consequently, of all the things we could give our children and grandchildren, surely one of the things for which they would be most grateful would be research and education programs that freed them from early death.

A simple thought experiment is useful in illustrating this point. If real income per capita in the United States grows at about $2\frac{1}{2}$ per cent per year in the future,¹⁰³ then in thirty years real income per capita would be twice the current level.¹⁰⁴ Suppose the United States, at the sacrifice of this growth, could completely conquer early death. Which would be the more desirable situation—being twice as rich at current levels of early death or being as rich as today with no early death? Or, to make the trade off less stark, which would be the more desirable situation—being twice as rich at current levels of early death or being half again as rich as today but with no early death? It seems reasonable to speculate that most people, upon deliberate consideration, would prefer the future with no early death, at least in the second of these two hypothetical choices. To the extent this speculation is correct, drastically reducing early death would be worth, roughly speaking, a trillion dollars or so per year to the next generation.

If we are going to give something to the future, we should probably give the conquest of early death rather than doubled affluence—if we have to make the choice. Expenditures, however, even of tens of billions of dollars per year, on health and safety research and education would not reduce economic growth to zero, even if all the money were taken out of investment and none out of consumption. Our descendants can have both increased affluence and decreased early death.

B. A Simple Model for Calculating the Value of the Benefits

Although this line of reasoning is perhaps convincing enough, some rough calculations may buttress it.

Since 1900 the incidence of early death has declined dramatically, at an average rate of about five percentage points per decade: The decline was graphed in Figure 3 *supra*. It is uncertain how much of this progress can be

103. This figure is consistent with the historical figures and the projections in H. KAHN & A. WIENER, *THE YEAR 2000*, at 118-127, 167-84, 180 (1967).

104. 1.025 raised to the 30th power is about 2.1.

attributed to, and how much future progress can be influenced by, public programs. Nonetheless, it seems clear that the greater the priority put on efforts to avert early deaths, the greater the rate of progress will be. To rephrase Victor Fuchs, "Within limits set by genetic factors, climate, and other natural forces, every nation chooses its" rate of progress against early death "by its evaluation of health compared with other goals."¹⁰⁵

Given the approximately linear trend in the reduction of early death since 1900, it may not be unreasonable to assume, as a rough and simple approximation, that the trend in the future will also be linear,¹⁰⁶ at least until the incidence of early death reaches some more or less irreducible minimum. Furthermore, since the rate of progress has been about five percentage points per decade and since much more rapid progress seems unlikely given the delayed effects of education and research programs, the future rate of progress might be assumed to be somewhat between one and ten percentage points per decade, the rate being determined, in part, by the priority placed on averting early deaths.

Table VI presents some estimates of the marginal benefits of increasing the rate of progress against early death. More precisely, for each of nine base rates of progress, ranging from one to nine percentage points per decade, the table presents three alternative measures of the value of increasing the rate of progress by one percentage point per decade. The first measure is the discounted present value of the stream of additional benefits that would be produced by such an increase in the rate of progress against early death. The second measure is the percentage of GNP it would be just worth spending, every year and for the indefinite future, to achieve these additional benefits. Finally, the third measure is the dollar amount currently equivalent to the percentage of GNP given by the second measure: that is, the third measure is simply the second measure multiplied by the current GNP. The estimates in Table VI were calculated from a simple model, the parameters of which can only be guesstimated.¹⁰⁷ Nonetheless, the estimates may be roughly right¹⁰⁸—and for the purposes of this article only approximate magnitudes are needed.

The figures in Table VI indicate that accelerated progress against early death is worth an increased annual expenditure of tens of billions of dollars. For example, if, under existing programs the incidence of early death would be reduced by three percentage points per decade, then, at current levels of GNP, it would be worth spending an additional \$28 billion every year to increase this rate of progress to four percentage points per decade—and an

105. Fuchs wrote: "Within limits . . . every nation chooses its own death rate." But since everyone dies sooner or later and since "things take time," it is more accurate to speak of the rate of progress against early death. V. FUCHS, *supra* note 50, at 18.

106. The historical data can also be well fitted by an exponential trend line. For further discussion of this, see Appendix, *infra*.

107. For a description of the model, see Appendix, *infra*.

108. For a discussion of this, see Appendix, *infra*.

additional \$24 billion (or some \$52 billion altogether) to increase the rate to five percentage points per decade.

These figures should perhaps be cut in a half or a third because "government dollars must do double and triple duty."¹⁰⁹ And of course, the figures are little more than educated guesstimates. But their multi-billion dollar magnitude is reassuring. Even if these estimates are only very roughly right, it seems clear that increasing the rate of progress against early death would be worth an increased expenditure of many billions of dollars per year.

TABLE VI
THE MARGINAL BENEFITS OF INCREASING
THE RATE OF PROGRESS AGAINST EARLY DEATH

<i>The Marginal Benefits of Increasing This Rate of Progress by One Percentage Point per Decade:</i>			
<i>Expected Rate of Progress Against Early Death, as Measured by the Number of Percent- age Points the Inci- dence of Early Death Would be Reduced per Decade</i>	<i>(1) As Measured by the Dis- counted Present-Value of the Stream of Addi- tional Benefits Pro- duced by This Increase (in Billions)</i>	<i>(2) As Measured by the Percentage of the GNP It Would Be Just Worth Spending, Every Year and for the Indefinite Future, to Achieve This Increase</i>	<i>(3) As Measured by the Ap- proximate Current Dol- lar Value of the Per- centage of GNP given by Measure (2) (in Billions)</i>
1	\$440	1.8%	\$28
2	432	1.7	28
3	405	1.6	26
4	363	1.4	23
5	317	1.3	20
6	273	1.1	17
7	234	0.9	15
8	202	0.8	13
9	174	0.7	11

Discussion: The table presents some estimates of the marginal benefits of increasing the rate of progress against early death, for various base rates of progress. For example, suppose it was expected that the incidence of early death would continue to decline in the future at the historic rate of five percentage points per decade. Then it would be worth spending an additional 1.3 percent of GNP (or about \$20 billion at current levels of GNP) to increase this rate of progress to six percentage points per decade. The discounted present-value of such increased progress against early death would amount to some \$317 billion.

Source: The table was calculated by the author on the basis of a mathematical model that is described and discussed in the Appendix *infra*.

Note: "Current GNP" was assumed to be \$1.6 trillion. The figures for measure (3) were calculated from the figures for measure (2) multiplied by this amount. Afterwards the figures in both columns were rounded off. Consequently, the rounded-off values for measure (3) may not be exactly 1.6 trillion times the rounded-off value for measure (2).

109. Zeckhauser explains: "It is an unfortunate fact, but true, that the government cannot support every project whose dollar return is positive In judging the appropriate level of expenditure . . . we must look not only to the returns to be derived from these efforts, but also the returns from projects which compete for funds." R. ZECKHAUSER, *SOME THOUGHTS ON THE ALLOCATION OF RESOURCES TO BIO-MEDICAL RESEARCH* 7 (Teaching and Research Mat. No. 5, Kennedy School of Government, Harvard University 1971).

CONCLUSION: POLITICS AND PRIORITIES

The current debate about health care in the United States largely concerns the financing of health care. The health "crisis" is generally perceived as a problem of mounting costs.¹¹⁰ The social losses and inequalities that a national health-care financing program might correct, large as they are, are dwarfed by the immense social losses and glaring inequalities caused by the tragically high incidence of early death in this country. Nonetheless, questions of how health-care costs can be controlled and what kind of insurance system should be used to pay for them are certainly important questions, worthy of substantial attention. One major reason is that the failure to control health-care costs may undermine efforts to provide additional funding for those programs that would reduce early deaths.

Greater progress could perhaps be made against early death without additional funding: Money currently being spent on early death is perhaps not being spent well. While this prospect certainly merits analysis, it may be even more difficult to achieve significant efficiency gains in current programs than it would be to expand these programs. Furthermore, there seems to be relatively little scope for efficiency gains, at least in the areas of research and education. As reported earlier, total national expenditure for health and safety research amounts to only about twenty dollars per year per person and for health and safety education to only a dollar or two per year per person.

Consequently it seems likely that accelerated progress against early death will require increased funding and that much of this funding will have to come at the expense of other kinds of health programs. Diverting resources by denying people over age sixty-five the kind of health care provided to younger people is probably infeasible, as well as undesirable, although it may be possible to cut back on the "heroic" (and expensive) efforts sometimes made to prolong marginally the lives of the terminally ill. But such age discrimination is not required to give greater priority to early death.

Nor is it a good way of doing so. There is considerable evidence that further general increases in medical services will have little beneficial effect on the health of the United States population and that marginal decreases would have little adverse effect.¹¹¹ In view of this and in view of the statistics presented earlier in this paper, it seems clear that the appropriate policy would involve:

- (1) limiting total medical care expenditures, for all age groups;
- (2) equalizing this level of care by providing better health services to non-whites, the poor, and residents of rural areas and inner cities;
- (3) increasing funding for biomedical, behavioral, environmental, and cross-national research, as well as for research to improve the quality

110. Report of the Overview Cluster 2.

111. For summaries of the evidence, see Neuhauser, *supra* note 91; V. FUCHS, *supra* note 50.

of the analyses underlying health and safety policymaking and regulation; and

- (4) increasing funding for the development of health and safety education programs and incentive programs.

Limiting medical care expenditures to divert additional resources into those programs that might significantly reduce early deaths will be a politically difficult and highly-charged task. Doing so will require bucking some strong trends. Personal health care expenditures have increased dramatically in recent years—nearly tripling from 1966 to 1975.¹¹² As shown in Table VII, health care expenditures are many times higher for those over age sixty-five than for those under this age—and the trend over the last decade has been for expenditures on the elderly to increase considerably more rapidly than expenditures on those under age sixty-five.

TABLE VII
HEALTH CARE EXPENDITURES AND
TRENDS IN HEALTH CARE EXPENDITURES
FOR INDIVIDUALS UNDER AND OVER AGE 65

<i>Measure</i>	(a)	(b)	<i>Ratio of b to a</i>
	<i>Individuals Under Age 65</i>	<i>Individuals Over Age 65</i>	
Total personal health care expenditures, per capita, in 1975	\$375	\$1360	(3.6)
Government-paid personal health care expenditures, per capita in 1975	\$108	\$892	(8.3)
Increase in total personal health care expenditures, per capita, in decade from 1966 to 1975	142%	205%	(1.45)
Increase in government-paid personal health care expenditures, per capita, in decade from 1966 to 1975	259%	571%	(2.2)

Discussion: Several times more is spent, per capita, on health care for those over age sixty-five than for those under this age. Furthermore, per capita health care expenditures have increased over the last decade considerably more for the elderly than for younger individuals.

Source: Calculations by the author from data in Mueller and Gibson, *Age Differences in Health Care Spending, Fiscal Year 1975*, 39 SOC. SECURITY BULL. 18, 29-30 table 7 (June 1976).

Furthermore, as shown in Table VIII, health care expenditures comprise the lion's share of federal health expenditures.

112. Mueller & Gibson, *Age Differences in Health Care Spending, Fiscal Year 1975*, 39 Soc. SECURITY BULL. 18, 29 table 7 (June 1976).

TABLE VIII

BREAKDOWN OF FEDERAL HEALTH EXPENDITURES, IN 1976

<i>Category</i>	<i>Percentage of Total Federal Health Expenditures</i>
"Health Care System"	92%
"Environment"	5
"Human Biology"	3
"Lifestyle"	0.5
TOTAL	100%

Source: NATIONAL PLANNING ASSOCIATION, *THE FEDERAL HEALTH DOLLAR, 1969-1976* (1977).

It is important that we get our priorities straight. Life and death numbers are unpleasant to contemplate, but "as a society we have to learn to respect such numbers more."¹¹³ In doing so we have to learn to think not about "lives saved" but about "quality-adjusted life-years gained." We have to realize that we could probably gain millions of quality-adjusted life-years by an appropriate package of early death programs, and that this is probably the only way we could gain so much life. And we have to begin worrying more about the equity of prolonging the lives of the elderly while not funding those programs that could avert the deaths of those who will never reach old age.

The benefits of reducing and, in time, eliminating early death would be enormous. The value of these benefits can be counted in the scores and hundreds of billions of dollars. But perhaps a clearer perception of the magnitude of the benefits can be gained by realizing that the conquest of early death would be one of the greatest achievements of mankind, one of the most valued gifts we could give the future, and, to the extent some progress can be achieved relatively soon, the gift of life itself to those most unfortunate of ourselves who will otherwise suffer the "crueliest of destinies."¹¹⁴

113. R. KEENEY & H. RAIFFA, *DECISION ANALYSIS WITH MULTIPLE, CONFLICTING OBJECTIVES* ch. 1, § 1.5.5 (1976).

114. See *ILIAD*, bk. 1, lines 386-87, where Thetis laments over the coming death of her son, Achilles. Robert Fitzgerald translates the lines as "Oh early death . . . No destiny so cruel."

APPENDIX

In Table VI some figures were presented on "the marginal benefits of increasing the rate of progress against early death." In the first part of this Appendix, the formulas that were used to calculate these figures are derived and briefly explained. In the second part, the sensitivity of the figures to changes in parameter values is explored. And in the third part, an alternative model based on an exponentially-declining incidence of early death is developed.

A. The Formulas for Table VI

1. *The Benefit Concept*

It is convenient to begin by defining the annual benefit of a "program" (or collection of programs, policies, private decisions, and natural events) that has the effect of steadily reducing the incidence of early death. In calculating Table VI, I assumed that this reduction would involve a decline of s percentage points per decade in the incidence of early death; the decline would continue until the early death rate reached some irreducible minimum, denoted m . (This assumption of a linear decline was based on the observation that the early death rate has fallen at a more or less constant rate per decade since 1900, as shown in Figure 3 of the text).

Let $b_t(s)$ be the benefit in year t of such program. Measuring $b_t(s)$ is a difficult and controversial task that involves estimating the monetary value society in the future would put on a lower early death rate. The approach I adopted is based on the simplifying assumption that the value of $b_t(s)$ is directly proportional to the progress made in reducing the early death rate. That is, I assumed that

$$(1) \quad b_t(s) = \pi_t(s) \cdot b_t^*$$

In this formula $\pi_t(s)$ is the proportion by which the early death rate would be cut in t years, given a rate of progress s against early death. For example, if the early death rate would be cut by a quarter, $\pi_t(s)$ would equal 0.25; if early death could be totally eliminated, $\pi_t(s)$ would equal 1.0. Consequently, b_t^* can be thought of as the value of the benefit, in year t , of totally eliminating early death.

The value of $\pi_t(s)$ is given by:

$$(2) \quad \pi_t(s) = 1 - \frac{k_t(s)}{0.26},$$

where 0.26 is the current value of the early death rate¹¹⁵ and $k_t(s)$ is what the early death rate would be in year t . Up until the time—call it y —when the early death rate is reduced to its irreducible minimum, $k_t(s)$ is given by:

$$(3a) \quad k_t(s) = 0.26 - (s/1000) \cdot t, \quad t \leq y.$$

(The reason s is divided by 1000 in this formula is simply that s is measured as a percentage per decade, while k is a proportion in some year.) And, of course, after the early death rate is reduced to its minimum level, m , then $k_t(s)$ is given by:

$$(3b) \quad k_t(s) = m, \quad t \geq y.$$

115. *Mortality Statistics, 1974*, at 5.

Finally, the year y when the early death rate reaches its minimum level is given by:

$$(4) \quad y = \frac{0.26-m}{s/1000}.$$

A difficult question remains: what is the value of b_t^* , the benefit in year t if early death were totally eliminated? As discussed in the text, it seems plausible that this value would vary with GNP, (at least if population levels stay roughly constant.) Indeed, it seems likely that as GNP increases, this benefit would be valued as an increasing proportion of the increasing GNP. The equation I used to capture this effect is the following:

$$(5) \quad b_t^* = f \cdot G_0 + g \cdot (G_t - G_0).$$

In the equation, G_0 is the current GNP (which I took to be \$1.6 trillion); G_t is the real GNP in year t ; f is the value society would currently put on ending early death, measured as a proportion of current GNP; and g determines the additional value society would put on ending early death as GNP increases: g is measured as a proportion of the "growth dividend" (i.e., the difference between future and current GNP).

Finally, the value of G_t , real GNP in year t , was assumed to be given by:

$$(6) \quad G_t = (1+r)^t \cdot G_0,$$

where r is the long-run average rate of economic growth.

These assumptions are sufficient to compute values of $b_t(s)$ for any s and for all future years t . It is standard practice to calculate the "total" benefit of a program as the discounted present value of the stream of future benefits. Let $B_t(s)$ be this present value. Then,

$$(7) \quad B(s) = \sum_{t=0}^{\infty} b_t(s)/(1+d)^t,$$

where d denotes the annual social discount rate.

In making decisions about whether to increase the intensity of public efforts to reduce the early death rate, it is useful to have an estimate of the marginal benefit of increasing s by, say, one percentage point. Let $M_1(s)$ be this marginal benefit as given by

$$(8) \quad M_1(s) = B(s+1) - B(s).$$

It is this measure which is presented first in Table VI.

Two informative alternative measures of marginal benefit are also included in Table VI. For some purposes, it is useful to measure the stream of benefits produced by some program by determining an equivalent stream of benefits, each of which is a constant proportion p of GNP. Let $p(s)$ be the value of p when the rate of progress against early death is s , and let $C(s)$ be the present value of the stream of amounts determined by $p(s)$. Then $p(s)$ is given by

$$(9) \quad C(s) = M_1(s),$$

where

$$(10) \quad C(s) = \sum_{t=0}^{\infty} p(s) \cdot G_t / (1+d)^t.$$

Since

$$(6) \quad G_t = (1+r)^t \cdot G_0,$$

this summation can be reduced to

$$(11) \quad C(s) = p(s) \cdot G_0 \cdot \frac{1+d}{d-r}.$$

Consequently, $p(s)$ is given by

$$(12) \quad p(s) = M_1(s) \cdot \frac{1}{G_0} \cdot \frac{d-r}{1+d}.$$

The second measure of benefit, $M_2(s)$, given in Table VI is simply

$$(13) \quad M_2(s) = p(s).$$

And the third measure, $M_3(s)$, is

$$(14) \quad M_3(s) = p(s) \cdot G_0.$$

2. Choosing Parameter Values

As described above, the values of the three benefit measures, $M_1(s)$, $M_2(s)$, and $M_3(s)$ are determined by five key parameters:

— f , the proportion of current GNP that is equivalent in value to the benefit of totally eliminating early death;

— g , the additional value of eliminating early death as a proportion of the difference between GNP in the future and current GNP;

— r , the annual rate of growth of GNP;

— d , the discount rate; and

— m , the irreducible minimum level of the early death rate.

In assigning values to these parameters in order to compute the figures in Table VI, I simply made some guesstimates that seemed plausible to me. I assumed that f is 0.10: that is, that currently society would value the benefit of ending early death as being equivalent to 10 per cent of GNP. And I assumed that g is 0.50: that is, the value society would place on ending early death would increase by \$1 for every \$2 real GNP increases.¹¹⁶ I predicted that the economy would grow at a rate r equal to three per cent. I used a discount rate of 10 per cent, a rate commonly used in governmental cost/benefit analyses.¹¹⁷ Finally, I assumed that the value of m would be one per cent, so that in the long run only one person in a 100 would be so unfortunate as to die before age sixty-five.

B. Sensitivity Analysis

Table IX presents some figures on how changes in these parameter values affect the magnitude of the three measures, $M_1(s)$, $M_2(s)$, and $M_3(s)$. Instead of presenting figures on these three measures for values of s ranging from 1 to 9, the table presents figures just for the case where $s = 5$. Focusing on one value of s makes the table shorter and easier to present and interpret; little information is lost as the results are essentially similar regardless of the value of s .

116. This value of 0.50 for g seemed plausible and perhaps even too low a value to me in light of the thought experiment concerning "what should the present give the future" that was described in Part V of the text. I have discussed this with a number of faculty and several groups of students at Duke University, and with only two or three exceptions, everyone agreed that it would be preferable to end early death while increasing GNP per capita by 50 per cent rather than to keep the early death rate at current levels while doubling GNP per capita.

117. See note 101 *supra*.

The message of the table is simply that even fairly substantial changes in any of the five parameter values do not alter the order of magnitude of any of the three benefit measures. Regardless of the changes, M_1 is in the hundreds of billions of dollars, M_2 is around one or two per cent, and M_3 is around ten or twenty billion dollars. Since the parameter values are little more than guesstimates, this robustness of the benefit measures is reassuring.

TABLE IX

THE EFFECT OF CHANGING PARAMETER VALUES ON THE THREE MEASURES OF THE MARGINAL BENEFITS OF INCREASING THE RATE OF PROGRESS AGAINST EARLY DEATH

Parameter Values	Value of the Benefit Measures (for $s = 5$)		
	$M_1(s)$ (in billions)	$M_2(s)$	$M_3(s)$ (in billions)
Parameter values used in computing Table VI	\$317	1.3%	\$20
Parameter values used in computing Table VI, except that f , the current value of elimin- ating early death as a proportion of current GNP, does not equal 0.10, but:			
— $f = 0.01$	260	1.0	17
— $f = 0.20$	380	1.5	24
except that g , the additional value of elimi- nating early death as a proportion of the dif- ference between GNP in the future and cur- rent GNP, does not equal 0.50, but:			
— $g = 0.25$	190	0.8	12
— $g = 1.00$	571	2.3	26
except that r , the annual rate of growth of GNP, does not equal 0.03, but:			
— $r = 0.02$	210	1.0	15
— $r = 0.04$	455	1.6	25
except that d , the discount rate, does not equal 0.10, but:			
— $d = 0.06$	866	1.5	25
— $d = 0.12$	207	1.0	17
except that m , the irreducible minimum lev- el of the early death rate, does not equal 0.01, but:			
— $m = 0$	327	1.3	21
— $m = 0.10$	199	0.8	13

C. An Alternative Model

Let everything be defined as before, except now assume that the incidence of early death declines not linearly but exponentially. In this case, the parameter s , which previously measured the number of percentage points the incidence of early death would decline per decade, will have to be redefined. Now let s be the number of percentage points the incident of early death would decrease in the first decade, *i.e.*, from now until ten years from now.

TABLE X

THE EFFECT, ON THE MARGINAL BENEFITS OF INCREASING THE RATE OF PROGRESS AGAINST EARLY DEATH, OF CHANGING THE NATURE OF THE DECLINE IN THE INCIDENCE OF EARLY DEATH FROM A LINEAR DECLINE TO AN EXPONENTIAL DECLINE

<i>The Expected Rate of Progress Against Early Death, as Measured by the Number of Percentage Points the Incidence of Early Death Would Be Reduced During the First Decade</i>	<i>The Marginal Benefits of Increasing This Rate of Progress by One Percentage Point, as Measured by the Discounted Present-Value of the Future Benefits, Under the Assumption that the Decline in the Incidence of Early Death Will Be:</i>	
	<i>Linear</i>	<i>Exponential</i>
1	\$440 billion	\$381 billion
2	432	347
3	405	317
4	363	290
5	317	267
6	273	246
7	234	228
8	202	211
9	174	196

Furthermore, a new formula is needed for $\pi_t(s)$, the proportion by which the early death rate would be cut in t years, given a rate of progress against early death as determined by s . Given the hypothesized exponential decline in the incidence of early death, it is useful to write this formula as follows:

$$(15) \quad \pi_t(s) = 1 - e^{-\rho(s)t}$$

But what is $\rho(s)$ in terms of s ? Because of the new definition of s ,

$$(16) \quad \pi_{10}(s) = \frac{s/100}{0.26}$$

(where s is divided by 100 because it is a percentage figure while π is a proportion and where 0.26 is the value used for the current early death rate). Equations (16) and (17) imply that

$$(17) \quad \rho(s) = -0.1 \log \left(1 - \frac{s/100}{0.26} \right)$$

These new equations can now be combined with the equations described previously to derive formulas for the benefit measures $M_1(s)$, $M_2(s)$ and $M_3(s)$, in much the same way as already discussed.

Table X compares the new values of one of these benefit measures, $M_1(s)$, with the old values. The fact that the values are roughly comparable provides some further reassurance about the robustness of the benefit figures. The same general pattern also holds for benefit measures $M_2(s)$ and $M_3(s)$ since, as indicated by equations (13) and (14), these measures are simply multiples of $M_1(s)$: with the parameter values I used, it turns out that $M_2(s)$ is about one 250-trillionth of $M_1(s)$. And $M_3(s)$ is 1.6 trillion times $M_2(s)$.